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MORTUARY CUSTOMS OF THE NAVAJO INDIANS.

BY R. W. SHUFELDT, M.D.

WHILE in New Mexico, a few years ago, the writer had abundant opportunities to study the various modes that the Navajo Indians resort to for the purpose of disposing of their dead. Heretofore it has been very generally supposed that this tribe practices but three well-defined methods of burial, and it is never their custom to deviate from them. I find, however, that the Navajos may choose any one of *four* means of disposing of their deceased, and in this matter they are very much controlled by circumstances.

First and by far the commonest method is the cliff burial, wherein the body of the man, woman, or child is removed from the lodge or "hogan" where the death took place, and is carried to some neighboring cañon, deposited without much ceremony in any of its semi-horizontal rents or fissures in its sides, and there thoroughly covered and walled in with pieces of rock and smaller stones. Most frequently this is performed at dusk, and the body of the deceased may be dressed in clothes that the individual possessed and valued during life. I have often seen their dead children decked out in buckskin garments, and wearing both bracelets and necklace of beads. The "hogan" in which the sick person succumbed is either abandoned or immediately burned, but in no event is it ever occupied by any of the tribe

again. They have a notion that the devil (*Chinde*) long haunts the locality where death has taken place, and they all shun it. After a burial the burial party thoroughly wash themselves and make a complete change of clothing. Often wolves or other wild animals may succeed in getting at a body thus placed in a rocky cleft, and, pulling it out, devour it, and the bones subsequently come to be scattered about in the neighborhood of the grave. This has led many to believe that the Navajos are careless of their dead, though there is no truth in this. A few years ago I remembered very well the danger that attended my efforts to secure a few Navajo skulls for Professor Sir William Turner, of the University of Edinburgh. It came to the ears of these Indians in the vicinity, and I was repeatedly cautioned not to make the attempt to carry out my designs.

On another occasion I was at the Navajo agency, Fort Defiance, in Northwestern New Mexico, and while there I learned that some fifty or sixty of these Indians had been buried at different times, extending over many years, in a kind of a cave up among the rocks of a neighboring cañon. I postponed my investigation of the place until daylight of the last day of my stay there, not breathing my plans to any one in the interim. With a large bag rolled up under my arm, and my ambulance awaiting my return at the entrance of the gorge, I climbed up to the place in a blinding snowstorm. Notwithstanding all my precautions, however, my reputation had gone ahead of me, and I found armed Indians posted in several localities, evidently there to resist my depredations at any hazard. They showed their agitation upon my approach, and I returned unsuccessful. Skulls of these Indians were, nevertheless, secured by me at a later date, and are now in the anatomical museum at the Edinburgh University.

Secondly, we may have what I will call here the *brush burial*, and it is resorted to principally in those cases where illness has been long and protracted and no hope for recovery is entertained. The patient is then taken out of the hogan, especially if he or she be old in years, and is carried to some secluded spot in the vicinity of their camp. Here the sufferer is densely surrounded with brush-cuttings as a protection against wild animals, and is

either at once abandoned to fate, or else may be fed from time to time by relatives until death comes in relief.

Navajos believe that an evil spirit or devil is at the bottom of everything that has in any way anything to do with death, and they rarely speak of their dead, for fear of offending the evil one; and it has been said that one of these Indians will freeze to death rather than build a fire for himself out of the logs of a hogan wherein one of their number has died.

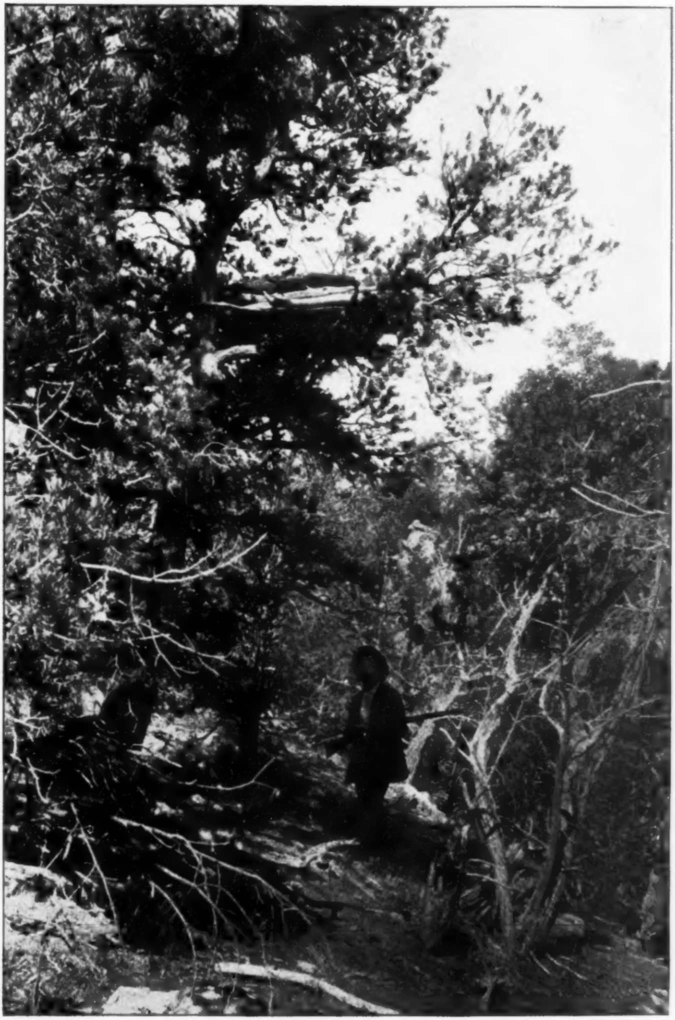
Next, or in the third place, the Navajos will resort to grave-digging as a means sometimes of disposing of their dead, and of this method I have seen one or two examples. While living at Fort Wingate, New Mexico, a few years since, there was a drunken brawl among some of those Indians at a hogan on a hill within a few steps of my house. During the fracas a Navajo squaw was shot and killed. The following day the party pulled down the hogan and burned it, and, wrapping the body of the woman in some cocoa coffee-sacks obtained at the trader's, they buried her on the spot in a grave so shallow that she was hardly covered from sight. A heavy log or two was placed to protect the corpse against dogs and wolves, and the place was abandoned. A year afterwards I secured her skull, and at this writing it adorns the top of one of the bookcases in my study.

In none of these burials do any ceremonies ever seem to be indulged in by the Indians; but it has been reported that the mourners, after the death of a relative, smear their foreheads and under their eyes with tar obtained from the piñon tree, leaving it there until it wears off, and do not renew it. I have never observed any custom of this character.

Others have said that in the event of a Navajo dying and leaving no kin, the lodge of the deceased is pulled down over his or her dead body, stones piled over it, with a few branches and mud, and the vicinity is at once deserted. Instances of this kind must also be rare, and it has never been my fortune to see a similar case. Sometimes the shallow grave is dug within the hogan, and the latter pulled down over it, and the Indians move away from the place as usual.

Fourthly, and last of all, the Navajos may occasionally resort to a tree burial. This practice with them, however, must be extremely rare, and up to the present writing I have succeeded in collecting but one instance of it. This occurred at about a mile from Fort Wingate, and its locality, as well as the mode of placing the body in the tree, are well shown in the plate illustrating this article, and which is a copy from a photograph. The deceased was a child, and its body was wrapped in a Navajo blanket and carried up into a large piñon tree to a horizontal limb about fifteen feet above the ground. At that point a rude platform had been constructed of dead and broken limbs, but the whole so arranged that after the body had been laid in its final resting place it supported it perfectly, and that completely in the horizontal position. I have never ascertained the name of the family of Indians to which this child belonged, nor why in its case they were led to make such a remarkable departure from their more common mortuary customs. Perhaps in times gone by some of the Navajos may have witnessed the practices of other tribes who were "tree-buriers," and thus had the idea suggested to them. All such theories, however, are purely speculative in the light of the meagre data now at my hand on this form of burial, though it in no way diminishes the interest that attaches to the settlement of such a point.

PLATE X.



A Navajo Tree Burial.

ON THE ORIGIN OF THE GALAPAGOS ISLANDS.

BY G. BAUR.

(*Continued from page 229.*)

I STARTED with the sentence that continental islands must have a harmonic flora and fauna. In the Galapagos we found absolute harmony; my conclusion, therefore, is: *The Galapagos are continental islands, originated through subsidence;* they all formed at a past period one large island, and this island itself was at a still former period in connection with the American continent. This result is in direct opposition to the opinion of all authors who have worked on this group of islands, like Darwin, Hooker, Salvin, Grisebach, Engler, M. Wagner, Wallace, Peschel. All declare that these islands are of recent volcanic origin, that they have emerged out of the sea through volcanic activity, and that they have become peopled from the continent successively. Henri Milne-Edwards alone holds a different opinion; he believes that the Galapagos represent the remains of a former continent, and in this opinion I agree.

The principal reason of the believers of the elevation theory is the volcanic condition of the islands. But I do not see any difficulty in that. If mountain ranges like the Himalayas, the Alps, the Andes, the Rocky Mountains, could be elevated thousands and thousands of feet, why could not subsidence take place in other places? If Central America should disappear by-and-by through subsidence, the result would be that the tops of the highest mountains would form volcanic islands, some with still active volcanoes. This would be exactly the condition we see to-day in the Galapagos. I think, therefore, that the volcanic nature of a group of islands is no positive proof of its recent origin. Such groups of islands can be just as well considered as formed by the tops of the volcanic mountains of a sunken part of a continent.

But at first let us consider how the facts of the distribution of flora and fauna agree with the elevation theory. Islands which

emerge from the sea can only be peopled accidentally, and must have a disharmonic flora and fauna. This is seen in all such islands, like the coral islands, which originated in this way. But in the Galapagos we found absolute harmony. Besides that we would have the greatest difficulty in explaining the presence of such peculiar forms as the gigantic land tortoises and the large lizards and the snakes, and so on ; and again we would have the greatest difficulty to explain the peculiar distribution of the forms, and their peculiar differentiation on the more peripheral islands. To take only one example, how is it imaginable to explain the presence of these gigantic tortoises, some of which reach a weight of 700 pounds ? They have not been introduced by man. When the islands were discovered by the Spaniards in the sixteenth century they were present in enormous numbers, like the other animals. According to the elevation theory we can only think of an accidental importation of these tortoises by some current, because they are quite unable to swim. After the islands had been elevated from the sea, and some vegetation had found its place there, it happened once, by a peculiar accident, that a land tortoise was carried over to the island. Alone it was helpless ; it could not propagate. This was only possible after a similar accident imported another specimen *of the same species, of the other sex, to the same island.* Or we could imagine that at the same time animals of both sexes were thus accidentally introduced. By this we could at least explain the population of a single island. But how did all the other islands become populated ? To explain this we would have to invoke a thousand accidents. But how can we explain that the members of one genus reached all the islands, and again those of another genus all the islands? *How can we explain that each island has a peculiar form of these genera? With one word, how can we explain the harmony of distribution by the theory of elevation?* All this is simply unexplainable by this theory.

The theory of subsidence, however, explains every point in an absolutely easy manner. All islands were connected together at a former period ; at this time the number of species must have been small ; through isolation the peculiar specialization of the

species began ; an originally single species was differentiated in many different forms ; every island developed its peculiar races.

What seems to me to be a support of the subsidence theory is the fact mentioned by Wolf, that the flora of the Galapagos at elevations of about 900 feet is typically that of the Andes at an elevation of 9,000 feet. How could this alpine flora be explained by the theory of elevation ; what is the reason that plants characteristic of an elevation of 9,000 feet are found at an elevation of 900 feet ? This peculiar fact is also explicable by the theory of subsidence. I have shown above that an elevation of 300 fathoms, or 550 m., would bring together all the central islands. There are two lines of soundings made by the Fish Commission Steamer "Albatross," one between the Galapagos and Panama, and one to Acapulco. The deepest sounding of the first line is 1,927 fathoms (3,470 m.), at 6° 44′ N., 80° 27′ W. ; that of the other is 2,256 fathoms, at 11° 45′ N., 97° 3′ W.

We need only an elevation of about 10,000 feet to connect the Galapagos with America. This would give the highest mountain on the Galapagos an elevation of 14,700 feet. This height is reached by many mountains and very often surpassed. The elevation of 900 feet on the Galapagos of to-day would correspond to an elevation of 10,900 feet. This is, of course, only an approximate value, which may be less or more. But there is no very great difficulty in adopting such an amount of subsidence.

The next question is, Is it not possible to determine during which geological period this subsidence of the Galapagos group, which we have to accept, has taken place ? If any form becomes isolated for long a time it preserves the original general character that it possessed at the time of its isolation. This we see very well exemplified by the study of isolated dialects of a language. *I believe, therefore, that the peculiar genera we find to-day on the Galapagos have not originated there, but have been preserved in their old condition.* Let us again take the tortoises as an example. The tortoises found on these islands belong to the true land tortoises Testudinidæ ; they represent, together with the forms from the islands round Madagascar and the peculiar Manouria from India and the Sunda Islands, the oldest living representatives of

the family. The paleontological history of the Testudinidæ reaches back to the Bridger Eocene. From this formation the oldest land tortoise, Hadrianus, has been recorded, which is nearly related to Manouria, characterized by the double caudal-shield, as in the Emydidæ. Forms very much like those from the Galapagos we find in the Miocene. *We do not go too far to say that it is probable that during the Eocene period, and possibly a little later, the Galapagos were still in connection with the continent.*

The important question is, Where was this connection? In their general characters the fauna and flora of the Galapagos show resemblances to the great Mexican and Sonoran province, and also to the West Indies. And it may be that the connection was with these regions (and it seems more probable than any other), but of course it is quite impossible to bring to-day any positive proof for this idea. It would appear that the whole west coast of America has undergone subsidence. We find there a great number of islands: Prince Wales, Queen Charlotte, Vancouver, Santa Barbara, Guadaloupe, and so on. That all these islands have been in connection with the continent at a former period seems to be certain. They appear as the result of subsidence. The Revilla Gigedo Islands are in the line of this sunken district. Farther south we find the small island Clipperton, and in a southeastern direction the Galapagos. Between Clipperton and the Galapagos two islands, Duncan and Galego, have been recorded; but they are of a doubtful nature,—at least they have not been seen again in latter times. But could we not imagine that they have disappeared in the course of this and the last century by subsidence?

Near the Mexican coast we have the Tres Marias Islands. These are considered as continental even by Wallace; but the more distant Socorro of the Revilla Gigedos are considered by Wallace as oceanic. Wallace believes, therefore, in subsidence in regard to the Tres Marias, in elevation in regard to the Revilla Gigedos, simply because there are no mammals on the barren Revilla Gigedos, and because they are placed within the thousand-fathom line. The fauna of the Revilla Gigedos is typical of that of lower California and the Sonoran province, and I believe also that the

Revilla Gigedos are nothing but a part of the American continent; they are also, like the Galapagos, within the 4000 m. line.

South of the Galapagos we have the islands Felice and Juan Fernandez, with their peculiar flora and fauna. It is not possible to determine whether there has been any connection between these islands and the Galapagos, but the fact that we find on the Galapagos three forms of Antarctic animals, which reach the most northern limit in this group, is to be mentioned. These animals are the *Otaria jubata*, *Arctocephalus australis*, and the peculiar penguin, *Spheniscus mendiculus* Sundev., only found on the Galapagos. Another interesting point is that the albatross, which so far as I know has only been described as breeding from the southern islands, especially Tristan daCunha, breeds on Hood's Island, as observed by Delano and Wolf.

Much work remains to be done. A great number of systematic deep-sea soundings have to be made between these different groups of islands and the continent. And the islands themselves have to be examined very carefully. We know nothing at all about the fauna and flora of the isolated Clipperton Island and Malpelo; we hardly know anything about Cocos Island, which seems to be in many respects quite different from the others, having a more tropical appearance. An enormous and highly interesting field of research is here open. After all this has been done, we may be able to discuss fully the question of the connection of the different islands. One thing, however, we assume to-day: *the probability of the origin of the Galapagos through subsidence.* But if this be probable for the Galapagos, how is it with the Sandwich Islands, for instance; so far as they are known they seem to be of the same harmonic nature in flora and fauna. Have they not originated in the same way? How about the other islands in the Pacific, and how about the theory of the consistency of the Pacific Ocean? Is this theory really established on a sound basis?

We now come to another very important question, What is the reason of the variation of the forms on the different islands? In other words, What is the origin of the different species of the different islands?

Of all the forms from the islands, the genus Tropidurus is best known. The most divergent species of this genus we find on Abingdon on one side, and on Hood on the other. On Abingdon we also find a peculiar species of Nesomimus, of Certhidea, of Cactornis, of Testudo, and probably of Geospiza. On Hood Island we also find a peculiar species of Nesomimus, of Certhidea, of Geospiza (Cactornis has not yet been discovered), and of Testudo. These forms are entirely different from each other, and different from the forms of the central islands. What is the reason of this difference? The fact is that *all* forms of an island become modified, and not alone a single species; the plants and the different groups of animals all at the same time. *There must be a common cause which produces this effect. And this cause can only be looked for in the surroundings, in the physical conditions of each island.* That there is a difference among these islands is evident. All the lower islands do not reach the damp region; they must be therefore in quite a different physical state. Some of these islands are without a drop of fresh water; others are furnished with this element. This difference must have a different effect on the same forms of animal and vegetable life.

I have expressed the opinion that when these islands were still in connection, forming one large island, there was probably only a single species of Tropidurus, Testudo, Nesomimus, and so on. There were probably certain small local variations, but they were not so expressed, being not separated; and besides that any new characters appearing were checked by intercrossing. We could imagine, for instance, that the large island had the higher moist region over its whole extent; the effect would have been that humidity was spread more equally over the whole island. If a certain portion became separated, and lost that upper horizon, it was at once in a fundamentally different condition. This affected the flora and fauna; and the flora again the fauna. All these changes, of course, must have gone on *very gradually.*

From these considerations we may proceed to get an explanation of the variation. Hoffmann and others have succeeded, in the course of several years, in changing wild plants by cultivation in gardens. Thus Hoffman could change the wild carrot

considerably, and this change became inherited. Let us consider what was done in this case. The wild carrot was isolated from the others, and brought under different conditions; it received, for instance, more food, and the effect was the change. It is exactly in the same way that we have to explain the change of forms on the different islands; an arid, dry island must have a different effect on an organism than a fertile and moist island. The different condition produces a different effect, and thus a different form. If the conditions were absolutely the same, the effect would be the same. Let us imagine that we have a form A, which has, and so have its ancestors, been for a long time in the same conditions. This form A will be represented at a certain moment by very numerous individuals of different age, between the egg and the senile stage. Now let us change the conditions; the change will affect this long series of individuals of the same species in a very different way. The new-born will react differently from the senile form. But among this long series of individuals there will be a certain number of organisms which will be *most plastic*, as I may express it, *to the stimulus of the new conditions*. The senile forms, for instance, probably are not affected at all; they die out through senility. Between these and the egg-stage, however, certain members must be in the condition which I call most plastic. The different individuals may be expressed according to their age, A^1, A^2, A^3, A^4, A^5, . . A^n.

A^n, the oldest individual, disappears by senility and A^{n-1} takes its place; the whole series is moved one line; the individuals of the greatest plasticity, for instance, do not remain the same, but are replaced by the next younger group. In this way a constant flow takes place, which continues until harmony is reached again between the individuals and the conditions.

I may explain this a little better by an example. The different stages of a plant, from the youngest to the oldest, may be expressed in a certain moment by A^1, A^2, A^3, A^4, A^5, . . A^n.

Now new conditions begin to appear, for instance, by the gradual disappearance of water. The result will be that the plant has to depend on less food than before; the large forms which have become so large through ample food will die out through senility;

others come in their place, but these will not develop so highly, because the necessary food is not given. The younger forms have to depend from the beginning on less food, and cannot grow to such extent as their ancestors ; the result probably would be the evolution of a smaller race. This will become constant as soon as it is in harmony with the surroundings. We can easily imagine a differentiation on the same spot, through the change of conditions ; but great effects are produced by isolation. If a part of the individuals of a certain form become separated, the slightest difference in the conditions of the new locality must work on the individuals, until harmony is produced. The absence of intercrossing of the separated forms will preserve the characters of each. I shall give an example for both cases, taken from the well-known communications of Vladimir Schmankewitsch.

Let us imagine that the brine shrimp (*Artemia salina*) is living in a salt-water lake which is supplied with fresh water by a river. Through some cause this river may be prevented from emptying its waters in the lake, being forced to take another course. The result will be that the water will increase gradually in density. By this gradual change *Artemia salina* will be transformed into *A. muhlhausenii.* Of course it is impossible that any adult Artemia is changeable ; but the changed conditions will have an effect on the egg and the younger plastic stages ; the old forms will disappear. The young ones will change until harmony with the surroundings is restored. Exactly the same will take place if *A. salina* is brought from its original locality to another place, in which the density of the water is greater than on the original locality. In the first instance a new species originates on the same spot, through the change of conditions ; in the second a portion of the individuals becoming isolated from the original stock develop into a new form.

This whole consideration is based on continuous growth, and on the fact that members of the same form are in a different stage of plasticity at a different age. If the harmony of a certain group is affected by the intercourse of any disturbing factor,—in other words, if the conditions are changed,—a general alarm is raised in the group until harmony is reëstablished. I may call

this process the process of harmonic growth, founded on the plasticity of the younger individuals. I believe that most of the variation goes on in certain definite directions produced by the conditions, this word taken in the widest sense. I do not believe that species originate through indefinite variation, produced by the mingling of different germ-plasmas on which natural selection works. I am inclined to believe that any change must stimulate the organism, and I think it is this stimulus which affects the germ-plasma just as well as the somatic plasma, if we want to make any such artificial distinction.

Perhaps we may be allowed to make some remarks in this connection about the inheritance of acquired characters. If any form shows a new character produced during the lifetime of the form, and not dependent upon any portion of the germ-plasma, we speak, in Weismann's meaning, of an acquired character of this form. I may use a very clear example, taken from Darwin: "The natives of the Amazonian region feed the common green parrot (*Chrysotis festiva* L.) with the fat of large Siluroid fishes, and the birds thus treated become beautifully variegated with red and yellow feathers. In the Malayan Archipelago the natives of Gilolo alter, in an analogous manner, the colors of another parrot, namely the *Lorius garrulus* L., and thus produce the Lori rajah or King Lory. These parrots in the Malay Islands and South America, when fed by the natives on natural vegetable food, such as rice and plantains, retain their proper colors."

Now here we have an acquired character. Will it be inherited? Certainly not, if the animal is fed with its natural food; but it will *appear again* when the animal receives the food producing the peculiar color. Another example: If an alpine plant is transported to a botanical garden, and has become different from the alpine form, it has acquired a new character. The question is, Is this character "inherited" by the next generation? The answer will be *yes*, if the conditions that produced this new character remain; for instance, if we leave the plant in the botanical garden. The answer will be *no*, if we change the conditions that produced that new character; for instance, if we bring the plant back to its original locality.

Hoffmann has given to the wild carrot a new character through long cultivation; this character has become inherited,—that is to say, seeds of the plants showing this acquired character show it again if placed in the same conditions. But let us plant the seeds in the original place; they do not receive the food they had in the cultivated ground, and will in a very short time fall back to the original wild state, simply, as it seems, because the conditions under which the character appeared are not given any more. The word inheritance is very often used in an absolutely wrong and misleading way. We cannot speak of direct inheritance of an acquired character; what is called here inheritance is simply the reappearance of the acquired character under the same stimulus; it is not, strictly speaking, inherited. For instance, we cannot say that the reduction of the biting muscles of lap-dogs is directly inherited. The biting muscles are simply kept low by the effect of the peculiar soft food that these animals receive, and by their peculiar mode of living; but if we change the food and bring the animal into different conditions, these muscles will increase again.

Inheritance is somewhat comparable to reflex motion and automatic motion. Inheritance in its beginning is comparable to reflex motion,—that is to say, a certain character appears under a certain stimulus. Inheritance is comparable to automatic motion when a certain character appears without that stimulus. In other words, the germ is first reflective, then automatic.

The difference between my opinion and that of Weismann is this: According to Weismann, the mingling of germ-plasma of different individuals produces variation, on which natural selection acts. According to my opinion, variation is the product of the stimulus of the conditions on the germ and somatic plasm; it is therefore definite. Variation goes on in certain definite lines. It is the surroundings which change the germ and somatic plasm, which determine variation.

That variation goes in definite lines, determined by the conditions in which the organism lives, is admitted by all those who ever studied species; I mean by all those who studied, for instance, all the representatives of a single genus and its geographical

distribution ; the researches of Joel A. Allen and Dr. Merriam are highly instructive in this line. It is also admitted by nearly all paleontologists. I have expressed the opinion that "inheritance" takes place only after a very long repetition of the same stimulus on an organism. Why is it not imaginable that under *certain* conditions, when the organization, instead of receiving an endless repetition of a stimulus, suddenly receives a single most effective stimulus, that the effects are inherited, and appear for some generations? I do not want to be misunderstood; I do not believe in the general inheritance of mutilations ; nobody can believe in such a theory. But that certain mutilations, under certain conditions, *may be inherited*, this I think is a possibility which cannot be entirely neglected. And we have to consider such cases, dark and unexplainable as they appear. Of course, in the origin of species, I do not think that this question is of any importance, If even certain mutilations in nature would become inherited, they could not have any influence whatever on the great harmonic number of the same species. I do not think that a species has ever been developed through inheritance of a mutilation. I think we are yet far from understanding the true nature of inheritance.

The objection will be made to me that I do not consider the sexes at all. To this I may reply that I am not inclined at present to lay so much stress on the effects of the mingling of different germ-plasmas. This mingling doubtless produces slighter or greater individual variation, and is certainly one factor of variation. But we have to consider that nearly all our researches on variation in this respect are based on domesticated organisms, which are, of course, under entirely different conditions from those in free nature. I can only think that certain even apparently most useful variations, created by the mingling of the germ-plasmas, must soon be swallowed up by the governing mass of harmonic forms, and are thus generally unable to develop a new branch. I consider sexual union more as a *stimulative* than a *formative* factor. *The same causes that produce variation in asexual animals must produce variation in sexual animals.* What we have to do is to study species and variation in nature; to study their conditions of life, their surroundings; to find out how these

are in relation to each other. Such a work, in fact, has never been done. Dr. Merriam has undertaken such a task, however, for some of the American mammals.

There is no other place on the whole earth which affords better opportunities for such a work than the Galapagos. Here we have the original natural conditions, hardly influenced by man. If all the variations of the forms on this group of islands, or even only the variations of a few genera, are studied, and the conditions of each variation are examined, then we may perhaps be able to express a more definite opinion on the causes of variation itself. Such work ought to be done *before it is too late.* I repeat, before it is too late! Or it may happen that the natural history of the Galapagos will be lost, as it has unfortunately been lost in so many islands; for instance, of St. Helena and the Mascarenes, lost forever, irreparably!

If I can succeed in raising the necessary funds, I shall try to do something for the solution of this important question. A visit of several months would bring out a good deal of light. The question of the origin of the islands themselves could be solved by the most careful collections of the flora and fauna of each, even the smallest island. The conditions of the flora and fauna as well as the domesticated animals which have become wild, could be studied on the spot. I may make some remarks upon this point. The following animals have become wild on the Galapagos, according to Wolf: Cattle, goats, horses, asses, hogs, dogs, cats, chickens. Cattle are found wild on Charles (8–900); Chatham (2–3000); South Albemarle some; horses only on Charles Island; and asses are very numerous on Charles, Chatham, Indefatigable, and Albemarle. They live together in troops of ten to fifteen. Why, Dr. Wolf asks, have these animals adopted the peculiar habit of sitting on the hind legs like a dog or a cat? And he adds that the most learned man could not help laughing at seeing these animals in this peculiar position. Goats are said to have diminished on account of the dogs. They are found on the arid mountains of Charles, Chatham, and Barrington. Hogs occur on all larger islands. Dogs live in droves in the upper and lower regions. The wild-cats on Charles and Chatham

are all black,—a peculiar fact, since this color is hardly ever seen in Ecuador. They live in the roughest fissures of the lava near the coast, hunting for crabs and fishes. Chickens are found on the highest most inaccessible regions of Charles. Also here a great field of research is open.

But besides these questions of general interest, some special points could be studied. For instance, material could be collected for the embryology of the penguin, the frigate-bird, the albatross, the seals, the Iguanidæ, and the large myriapod Scolopendra.

"The ground is classic ground," says Mr. Salvin, "and the natural products of the Galapagos Islands will ever be appealed to by those occupied in investigating the complicated problems involved in the doctrine of the derivative origin of species."

But beside studies in nature, we need experiments; biological experimental stations would be of an enormous help in the question of variation. Our means of communication and transportation are so highly developed to-day that it is easy to get animals and plants from very remote places in short time; by bringing these organisms in different conditions a great number of very valuable experiments at least could be made.

I will finish these considerations, which I hope will be taken for what they are,—*ideas—not definite opinions*,—with a word from Darwin, in a letter to M. Wagner:

"In my opinion, the greatest error which I have committed has been not allowing sufficient weight to the direct action of the environment,—*i. e.*, food, climate, etc.,—independently of natural selection."

Clark University, Worcester, Mass., December 6th, 1890.

PRINCIPAL BIBLIOGRAPHY OF GALAPAGOS ISLANDS.

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REVIEW OF THE PROGRESS OF AMERICAN INVERTEBRATE PALEONTOLOGY FOR THE YEAR 1890.

BY CHARLES R. KEYES.

SINCE the last consideration of the subject in this journal important contributions to American invertebrate paleontology have been made. The number of titles is considerably in excess of that of last year. Several extensive state reports have appeared; but the large majority of the papers issued have been incorporated in serials. With the exception of a few brief presentations on small zoological groups no monographical works have been distributed during the year just closed. The several great works alluded to last year as in an advanced state of preparation have been necessarily delayed by the discoveries of much new material; but the evidence at hand clearly indicates that the delay will not be unaccompanied by more suggestive results than could otherwise have been reached.

Excepting those proposed in a single brochure which has not as yet been generally distributed, the number of new species considered is very much below that of any similar period during the past decade, thus greatly emphasizing the statements made in the last "review." On a former occasion the fact was mentioned that the interdependence of the stratigraphical geologist, the biologist, and the paleontologist is constantly becoming more and more intimate. This suggestion has never been more fully corroborated than by the recent appearance of several most valuable morphological memoirs, based largely upon critical studies of extinct forms of life. Nor is the reality of the remark less apparent in certain late articles dealing with problems of stratigraphy.

In the annual report (pp. 116–120) of the Geological and Natural History Survey of Canada, Henry M. Ami has a Systematic List of Fossils with Localities referred to in Report K.

Charles E. Beecher, has in the *American Journal of Science* (3), Vol. XL.: North American Species of Strophalosia, pp. 240–246; On Leptænisca, a New Genus of Brachiopod from the Lower

Helderberg Group, pp. 238–240, 1 plate; Koninckia and Related Genera, pp. 211–219, 1 plate; and On the Development of the Shell in the Genus Tornoceras Hyatt, pp. 71–75.

I. P. Bishop communicates a note on A New Locality of Lower Silurian Fossils in the Limestone of Columbia County, N. Y., to *American Journal of Science*, Vol. XXXIX., pp. 69–70.

Samuel Calvin describes Some New Species of Paleozoic Fossils, in the Bulletin of the Laboratories of Natural History of the State University of Iowa, Vol. I., 173–181, 3 plates; also, Note on a Specimen of *Conularia missouriensis* Swallow with Crenulated Costæ, in *American Geologist*, Vol. V., pp. 207–208.

E. J. Chapman has some Remarks on the Classification of the Trilobites, with Outline of a New Grouping of These Forms; Transactions Royal Society of Canada, Vol. VII., Sec. vi., pp. 113–120.

William B. Clark notes the occurrence of certain fossils, in a Third Annual Geological Expedition into Southern Maryland and Virginia; Johns Hopkins University Circulars, No. 81, pp. 69–71.

J. M. Clarke has: As Trilobitas do Grez de Ereré e Maecurú Estado do Pará, Brazil, in the Archivos de Museu Nacional do Rio de Janeiro, Vol. IX., pp. 1–57, two plates.

E. W. Claypole considers a new form of crustacean in Paleontological Notes from Indianapolis; *American Geologist*, Vol. VI., pp. 255–260.

F. W. Cragin, in the Bulletin of Washburn College, Vol. II., pp. 65–68, has Contributions to the Paleontology of the Plains.

Coral and Coral Islands (third edition), by James D. Dana, has appeared, with considerable new material added. The author also has a note on fossils in the Taconic limestone belt at the west foot of the Taconic Range in Hillsdale, N. Y., in *American Journal of Science* (3), Vol. XL., pp. 256, 257.

William H. Dall contributes to the knowledge of the Tertiary Fauna of Florida; Transactions of the Wagner Free Institute of Science, Vol. III., pp. 1–200, 12 plates.

J. William Dawson has: A Note on a Fossil Fish and Marine Worm Found in a Pleistocene Nodule in Green's Creek, Ottawa, in *Canadian Record of Science*, Vol. IV., pp. 86–88; On Burrows

and Tracks of Invertebrate Animals in Paleozoic Rocks, and Other Markings, in the Quarterly Journal of Geological Society of London, Vol. XLVI., pp. 595–618; and On New Species of Fossil Sponges from the Siluro-Cambrian at Little Metis, on the lower St. Lawrence, in Transactions Royal Society of Canada, Vol. VII., Sec. iv., pp. 31–55.

In the *Canadian Record of Science*, Vol. IV., pp. 104–109, William Deeks gives a List of Fossils from the Lower Helderberg formation of St. Helen's Island.

W. W. Dodge notes Some Lower Silurian Graptolites from Northern Maine, in the *American Journal of Science* (3), Vol. XL., pp. 153–155.

P. Martin Duncan, in the Journal of the Linnæan Society, Vol. XXIII., pp. 1–311, gives a Revision of Generic and Great Groups of the Echinoidea.

R. W. Ells lists many fossils in his Second Report on the Geology of a Portion of the Province of Quebec; Annual Report Geological and Natural History Survey of Canada, Vol. III., Report K.

Oliver Everett with E. O. Ulrich describes some new Silurian sponges, in the Geological Survey of Illinois, Vol. VIII., pp. 253–282.

A. H. Foord revises the Group of *Nautilus elegans* Sowerby; *Geological Magazine* (3), Vol. VII., pp. 542–552.

C. H. Gordon gives his Observations on the Keokuk Species of Agaricocrinus, in the *American Geologist*, Vol. V., pp. 257–261; and On the Keokuk Beds at Keokuk, Iowa, in the *American Journal of Science* (3), Vol. XL., pp. 295–300.

James Hall has an abstract On New Genera and Species of the Family Dictyospongidæ, in Bulletin of the Geological Society of America, Vol. I., p. 22. Also Some Suggestions Regarding ing the Subdivisions and Grouping of the Species Usually Included Under the Generic Term Orthis, in Accordance with the External and Internal Characters and Microscopic Shell Structures; pp. 19–21 of same publication.

A Preliminary Catalogue of the Fossils Occurring in Missouri

is given in Bulletin No. 1, Geological Survey of Missouri, pp. 60–85, by G. Hambach.

The Occurrence of Goniolina in the Comanche Series of the Cretaceous is noted by R. T. Hill in the *American Journal of Science* (3), Vol. XL. pp. 64, 65.

Jos. F. James discusses the Maquoketa Shales and their Correlation with the Cincinnati Group of Southwestern Ohio, in the *American Geologist*, Vol. V., pp. 335–356; and, On Variation, with Special Reference to Certain Paleozoic Genera, in AMERICAN NATURALIST, Vol. XXIII., pp. 1071–1087.

T. Rupert Jones describes Some Paleozoic Ostracoda from North America, Wales, and Ireland, in Quarterly Journal Geological Society of London, Vol. XLVI., pp. 1–30; also in the same journal, pp. 534–556, Some Devonian and Silurian Ostracoda from North America, France, and the Bosphorus; and Some Fossil Estheriæ, in the *Geological Magazine*, Vol. IX., pp. 385–390.

Charles R. Keyes has a Review of the Progress of American Invertebrate Paleontology for the Year 1889, in the AMERICAN NATURALIST, Vol. XXIV., pp. 131–138; Certain Forms of Straparollus from Southeastern Iowa, in *American Geologist*, Vol. V., pp. 193–197; Genesis of the Actinocrinidae, in AMERICAN NATURALIST, Vol. XXIV., pp. 243–254; Generic Relations of Platyceras and Capulus, in the *American Geologist*, Vol. VI., pp. 6–9; Note on the Preservation of Color in Fossil Shells, in *The Nautilus*, Vol. IV., pp. 30–31; Synopsis of American Carbonic Calyptræidæ, in Proceedings of the Academy of Natural Sciences, Philadelphia, 1890, pp. 150–181; Discovery of Fossils in the Limestones of Frederick County, Maryland, in Johns Hopkins University Circulars, No. 84, p. 32; and The Naticoid Genus Strophostylus, in the AMERICAN NATURALIST, Vol. XXIV., pp. 1111–1117.

Remarks on the Nature of Organic Species are given by Joseph Leidy in Transactions Wagner Free Institute of Science, Vol. II. pp. 51–53.

J. P. Lesley has issued Volumes II. and III. of his Dictionary of Fossils; P 4, Geological Survey of Pennsylvania.

Joshua Lindahl has prepared a General Index to the Eight Re-

ports of the Illinois Geological Survey; Paleontology, pp. 62–151 of appendix.

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RECENT STUDIES OF THE VERTEBRATE HEAD.

BY H. W. NORRIS.

(*Continued from page 102.*)

FROM researches on Amphioxus and the Craniata Van Wijhe ('89) concludes that the skull never consists of metameres; that only in the occipital region behind the vagus were there at one time separate cartilaginous neural arches. The parietal musculature, and the peripheral nervous system, with the exception of the I., II., and III. nerves, were once segmented in the region of the head, as well as in the body. The number of the myotomes of the head is in general nine, but in those Craniata which have no hypoglossus, less. To a cranial or a body segment belong both a dorsal and a ventral nerve, which were originally separate. Wherever in the Craniata the ventral roots are wanting the corresponding myotomes do not appear. The vagus is a complex of two dorsal nerves. There are no grounds for assuming that the Craniata ever possessed more than eight branchial sacks, unless an additional aborted one belongs to the hyoid arch.[1]

Beard ('89*a*) states that certain portions of the cranial and spinal nerves arise not as outgrowths from the central nervous system, but from the ectoderm just outside the neural tube. This mode of development agrees with that described by Kleinenberg for the parapodial ganglia of Annelida. The parapodial ganglia arise as ectodermal differentiations just above the lateral limit of the ventral cord, and like the ganglia of vertebrates arise segmentally. It is to be noted that Rabl and Dohrn both controvert the above theory. Beard farther says that before the closure of the two limbs of the neural plate the neuro-epithelium of one limb is separated from that of the other by a ciliated groove. Two bands of neuro-epithelium separated by a ciliated groove are characteristic of Annelids. This ciliated groove in vertebrates later forms most, if not all, of the ciliated epithelium of the permanent central canal.

[1] It is interesting to compare the above statements of Van Wijhe with the more recent observations of Dohrn.

Beard ('89*b*) reiterates his former conclusions that the nose, like the ear, represents a branchial sense organ. The olfactory nerve, like a typical branchial nerve, develops from two sources: from the ectoderm just outside the foundation of the central nervous system, and from the special neuro-epithelium.[2] The latter grows in length by increase within itself, and later on in development, in many cases it divides up into a number of smell-buds, comparable exactly to the sense organs of the lateral line. The origin of the olfactory nerve in reptiles is essentially similar to that in Elasmobranchs. In the chain connecting the sensory cells of a vertebrate sense organ with the central nervous system there are ganglion cells arising from three different sources: from the neuro-epithelium itself; between the lateral ganglion and the central nervous system; as a special differentiation in the central nervous system. Jacobson's organ is a specially differentiated part of the nose. There is nothing in the development of the nose *per se* to suggest a gill-cleft.

Golowine ('90*a*) confirms many of the statements of Beard. He thinks that in the chick the ectoderm situated at the sides of the not-yet-closed medullary tube represents two sensitive organs, and that from these latter the ganglionic system is developed. Beard had stated that the ganglion Anlagen are, after the first stages, independent of the ectoderm, but Golowine observed their formation from ectoderm cells up to the time the neural ridge is complete. In most respects he agrees with Beard as to the origin of the Anlagen. Before the neural ridge segments it becomes separated from the sensitive ectoderm by a layer of indifferent ectoderm. Thus in the so-called sensitive organ can be recognized two distinct portions: ganglion Anlagen and the Anlagen of the special sense organs. The neural ridge in the cephalic region divides successively into three ganglion groups. Kastschenko's conclusion that the dorsal parietes of the medullary tube degenerates to such an extent that a second closing occurs is erroneous. As the neural ridge divides, to each ganglionic segment corresponds a segment of sensitive ectoderm, which

[2] Beard, it should be remembered, holds that the neural ridge is independent of the central nervous system.

latter is to be regarded as an organ of special sense. The subsequent development of the ganglionic system is entirely independent of the special sense organs. Though later the ganglia in the region of the head are directly connected with the branchial sense organs, yet the former are never developed at the expense of the latter, Beard, Froriep, and Spencer to the contrary. The olfactory ganglia are probably formed from the neural ridge. They are not derived from the cells of the nasal fossa. The posterior roots of the cranial and spinal nerves are at first cellular, and are formed from that part of the neural ridge placed between the dorsal borders of the medullary tube.

Houssay ('90), in his observations on the development of the Axolotl, agrees with Beard as to the ectodermal origin of the Anlagen of the dorsal nerve-roots The cranial ganglia first appear as an unsegmented ectodermal band, which afterwards extends into the trunk, forming the lateral line and nerve. In the meantime, while this posterior differentiation is occurring, the band anteriorly segments to form the cranial ganglia. The central nervous system, though at first unsegmented, is soon metameric, both in brain and spinal cord, and this metamerism is called "neurotomy." The dorsal nerve-roots arise each behind the "neurotome" of its segment,[3] this relation being secondary. The author thinks there is a complete homodynamy of the peripheral nervous system in all the metameres of the body. In discussing the metamerism of the head he states that the segments do not appear with any regularity as to time and location. The neurotomes, neuromeres, branchiomeres, and myotomes agree in the manner of segmentation. He believes he finds evidence of the existence of an oculohypophysial, a buccal, a hyomandibular, and an auditory segment. The IV. and VI. nerves cannot be certainly identified as ventral roots.

Gaskell ('89*a*, '89*b*, '90) considers the central nervous system of vertebrates as made up of two parts: a non-nervous supporting tube, and a nervous portion surrounding that tube. He bases his observations on Ammocœtes, and concludes that the non-nervous tube is the altered alimentary canal of a Crustacean-like

[3] *Vide* Platt and McClure.

ancestor. The functions of the supraœsophageal and the infrasœophageal ganglia and the ventral chain correspond to the functions of those parts of the vertebrate central nervous system which are situated in the same anatomical position, with respect to the non-nervous tube, as the corresponding ganglia of the Crustacean with respect to the alimentary canal. The Crustacean cephalic stomach is represented in the brain of the Ammocœtes by the choroid plexuses, the continuation of the tissue of the latter that lines the cavities of the brain being the ventral portion of the stomach walls. The nervous masses lying outside this lining epithelium are probably composed of tissue arranged in the same way and of the same structure as the supraœsophageal, infraœsophageal, and thoracic ganglia of the Crustacean-like ancestor. The two nervous masses which form the brain proper and olfactory lobes are in the position of the supraœsophageal ganglia with respect to the walls of the cephalic stomach, and in connection with a special optic portion which gives rise to eyes of a strictly Arthropod type. Rudiments of the old mouth and œsophagus are seen in the infundibular process. A bilaterally arranged mass of pigmented tissue that fills up a large portion of the space around the brain is looked upon as the rudiment of the Crustacean liver, while its duct is seen in the conus postcommissuralis. The pigment is regarded as the remains of the blood channels of the old cephalic liver. The original Crustacean-like ancestor had a pair of median eyes, represented in the Ammocœtes by the "dorsal" and "ventral" pineal eyes, the dorsal eye remaining functional much longer than the ventral. The central nervous system of the Ammocœtes, and therefore of all other vertebrates, is the direct descendant of the Arthropod nervous system in all respects. The vertebrate alimentary canal is formed by the prolongation of a respiratory chamber, the latter containing the gill-bearing legs of the ancestral form; the legs being still present in Ammocœtes in the form of branchial bars. The segmental cranial nerves are the nerves arising from the infraœsophageal and thoracic ganglia. The first two cranial nerves are the nerves of special sense arising from the supraœsophageal ganglia.[4]

[4] To fully comprehend the above theory one must ignore all morphological principles.

Miss Platt ('89) finds that in the chick the first mesodermal cleft occurs anterior to the first protovertebra, and that two protovertebræ are subsequently formed anterior to this cleft. The four pairs of protovertebræ entering into the formation of the head are thus evenly divided by the first mesodermal cleft. During the second and third days of incubation the medullary tube becomes divided by a series of constrictions into vescicles or neuromeres. Anterior to the first protovertebra there are seven of these neuromeres. As the protovertebræ are successively formed, neuromeres are added, each opposite a protovertebra; but as the neuromeres often appear before the corresponding protovertebræ, the former are independent of any mechanical influence of the latter. The anterior neuromere gives rise to the prosencephalon, thalamencephalon, and mesencephalon. The development of these three brain vescicles is coincident with the cranial flexure, and the latter may be due to the rapid development of the dorsal and lateral walls of the first cerebral vescicle. From the second neuromere is developed the cerebellum. The succeeding vescicles, including those between the first five protovertebræ, share in the formation of the medulla oblongata. Orr and Béreneck correctly described the number and appearance of the neuromeres, and the ultimate relations of the cranial nerves to these medullary folds observed by them in the lizard and chick are the same as those observed by Platt in the salmon and chick. The primitive relation in the chick is different. The V. nerve arises not as Béreneck says, from the outward convexity of the first neuromere of the medulla, but from the concavity between the first and second neuromeres. Opposite this concavity a ridge[5] projects into the fourth ventricle, composed of lines of cells converging like the rays of a fan toward the point of origin of the V. nerve. At the time when the VII. and VIII. nerves have just left the neural ridge, from the concavities between the second and third and the third and fourth neuromeres spring nerve-fibres which unite in a large ganglion. Thus at an early period the VII. and VIII. nerves are distinct from each other, but as the third neuromere is smaller than the others the space between the roots

[5] See Orr. *Journ. Morph.*, Vol. I., No. 2, p. 335.

of these two nerves is very slight. The IX. nerve arises from the concavity between the fourth and fifth neuromeres. The X. nerve is evidently made up of the fused roots of several spinal nerves. The latter arise like the cranial nerves from corresponding concavities in the spinal cord. The cranial neuromeres are to be regarded as homologous with the neuromeres of the spinal cord. Orr stated that the internal ridges projecting into the fourth ventricle corresponded not to the nerve-roots, but to the spaces between the nerve-roots. In Acanthias, Platt ('90) describes a pair of head-cavities anterior to the premandibular cavities. This observation is of great interest in the light of Dohrn's recent studies on Torpedo.

While many observers have noted the relations of the cranial nerves to the neuromeres, McClure ('89, '90) seems to be the first to attempt to comprehend the entire brain in a schematic, segmental arrangement of neuromeres. Basing his observations on the embryos of Amblystoma, Anolis, and the chick, he concludes that the primitive brain consisted of approximately ten neuromeres, which, beginning with the anterior, he calls olfactory, optic, oculomotor, trochlear, trigeminal, abducens, facial, auditory, glossopharyngeal, and vagus neuromeres respectively. He follows closely the observations of Orr on the lizard, and quotes his definition of a typical neuromere.[6] The forebrain is to be considered as consisting of two neuromeres and possibly part of a third, the midbrain of two, and the hindbrain of six. "The olfactory neuromere is connected with the olfactory nerve." The two neuromeres of the forebrain described by McClure are the same as those described by Orr in the region of the thalamencephalon of the lizard posterior to the secondary forebrain. But Orr says "they never give off any nerves." As McClure studied Orr's preparations, this disagreement is interesting. The segmental nerve belonging to the optic neuromere is assumed to have degenerated. The midbrain probably consists of two neuromeres, since the III. and IV. nerves arise from this brain segment, and the view is further strengthened by the fact that Scott figures in Petromyzon an appearance of neuromeres in the midbrain.

[6] Orr. *Journ. Morph.*, Vol. I., No. 2, p. 335.

Hoffmann found that the trochlear nerve arises in the lizard from the anterior neuromere of the hindbrain, and subsequently shifts forward to the midbrain. McClure promises to prove that Hoffman has probably mistaken the posterior segment of the midbrain for the anterior segment of the hindbrain, but as he figures in the chick and lizard an unnamed neuromere between the midbrain and trigeminal neuromere, the promise is not fulfilled. This unnamed neuromere is described by Orr. Hoffman says it forms part of the cerebellum. Miss Platt, with whom McClure closely agrees in many points, but whose work he utterly ignores, states essentially the same. Four neuromeres of the hindbrain give rise to dorsal nerve-roots. The abducens and auditory neuromeres possess no nerve-roots, and in Amblystoma the abducens neuromere is wanting. The VI. nerve cannot be certainly identified with any neuromere. It should be noticed that while McClure gives theoretical evidence for the separate origin of the VII. and VIII. nerves, Miss Platt has already demonstrated the same. McClure agrees with Miss Platt in homologizing the neuromeres of the brain with those of the spinal cord. He considers the dorsal roots of the nerves to arise from the outward convexity of the respective neuromeres, or to be intersomitic. Miss Platt says that in the chick the spinal nerves spring from the internal ridge opposite the myotomes or somites. Houssay says that in the Axolotl the dorsal nerve-roots arise each behind the neurotome of its segment. Nine myotomes in the body region would correspond to the nine spaces between ten neuromeres of the spinal cord. Therefore our author says the nine mesodermal head-somites, or myotomes, of Van Wijhe "theoretically correspond to the nine spaces between the ten encephalomeres."[7]

Ayers ('90*a*, '90*b*) sees in Amphioxus, which, as Steiner showed, consists of a series of physiologically equal segments, a region comparable to the brain of higher vertebrates. The anterior end of the neural axis of Amphioxus is a brain, for it terminates the

[7] This statement shows a surprising lack of acquaintance with the morphology of the head. Moreover, Dohrn's recent investigations show conclusively that the primitive brain consisted of many more than ten segments.

neural axis anteriorly; it is intimately connected with the sense organs, eye and nose; it gives off at least two pairs of sensory nerves with peripheral ganglia; it possesses ganglionic centers of coördination; it has an enlarged central canal with three diverticula, two optic and one olfactory; it is the largest part of the nervous system in early stages; it possesses a cranial flexure; it shows a differentiation into ganglionic and fibrous tracts. The large collections of ganglion cells just posterior to the thalamocœle are homologous with the medullary nuclei of other vertebrates. In the ontogeny of other vertebrates the brain passes through a condition which remains as adult in Amphioxus. All the sense organs of the anterior end of the body of Amphioxus are probably paired. The eye-spot is the forerunner of the vertebrate eye, and shows several stages in development. The pigment of the eye-spot is contained in cells that lie normally inside the bounds of the nerve-mass. The pigment bodies form a part of segmental sensory structures. Each of the pigment bodies forms a deposit in an amœboid cell. The pigment of the the axial nervous system of Amphioxus is in process of migration towards the anterior end of the body. The vertebrate ear has developed within the phylum above Amphioxus, and arose from one of the primary sense organs of the lateral line system, at a period phylogenetically later than the formation of the canal system of these sense organs. The ear capsula does not separate two morphologically different portions of the brain.[8] The higher sense organs of all the Cyclostomata are all paired. The parietal-pineal eye of the Cyclostomata and other vertebrates has been developed from a median portion of the pigmented eye of Amphioxus. The neural axis of all vertebrates is coëxtensive with that of the chorda. The pituitary prominence of the skull of vertebrates does not mark a fixed point. The chondro- or ossicranium possesses no more segmental value than the intestine. The head-cavities possess relatively the greatest importance before a primordial cranium has made its appearance. The hypophysis arose in the vertebrate phylum long after the appearance of the chorda, and was connected with the infundibulum. It arose as a

[8] See Rabl. Theorie des Mesoderms.

taste organ, and the infundibulum was its nerve. The optic and trochlear chiasms have arisen within the vertebrate group above the Amphioxus condition. The large number of gill-slits in Amphioxus is due to physiological conditions, the branchial apparatus serving for collecting food as well as for respiration.

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BY J. S. KINGSLEY.

(Continued from Vol. XXV., page 259.)

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RECENT LITERATURE.

TO THE EDITOR OF THE AMERICAN NATURALIST:

DEAR SIR: I have just seen the review of the "Guide for Science-Teaching," No. VIII., on "Insecta," in the January number of the AMERICAN NATURALIST. One sentence of that review cannot be passed unnoticed by those who are laboring for the cause of science-teaching. When Mr. Kingsley says: "We cannot help wishing that we had some really first-class text-book of entomology which would attack the subject from every side," I must reply, emphatically, that this was the very thing we did not aim to write, and which we did not think was needed.

As is well known, the "Science-Guides" are written for the great body of teachers of our public and private schools,—that is, for teachers of the young from five to eighteen years of age. Do these teachers need a text-book which shall attack the subject from every side, or a guide *to show them how to make their pupils attack the subject from a few sides?* Will boys and girls trained from early childhood to do this by direct observation and comparison of specimens in hand *need a text-book* when they enter college? I think not. Nowhere along the way is a text-book needed, even if it be "first-class," and nowhere should it be placed between nature and the child. It may be that the special student in college or the professor would find a *reference book*, presenting the subject from every point of view, very convenient, but it is not for specialists that those most deeply interested in the cause of science-teaching are working. These recognize the fact that while the science primer, conceived in the scientific spirit, but treating the subject from a few sides, may shoot far below the minds of specialists, a reference book, treating the subject from every side, would fall as a heavy weight upon the teachers of the young, *because it would not meet their imperative needs.*

The time has come when we must explain the ways and means whereby teachers shall be able to make their large classes of children do independent observational and mental work,—in a word, scientific work,—and when this difficult task is accomplished we may rest assured that the power thus gained by the young will enable them to seek and find for themselves those original sources of knowledge on any given subject which are contained in many libraries. We may go even a step farther and make the logical prediction that this same power will enable some of them, perhaps, to add to the stock of absolute knowledge.

I desire to thank Mr. Kingsley for the expression of his views on other subjects concerning which naturalists are by no means agreed, and I write this reply only because the part of his review to which I have taken exception touches upon what Professor Hyatt and I consider a vital principle of science-teaching.

Respectfully yours, J. M. A.

General Notes.

GEOLOGY AND PALEONTOLOGY.

On a Collection of Fossil Birds from the Equus Beds of Oregon.[1]—Silver Lake is one of the alkaline lakes of Oregon, and lies somewhat to the southward of the middle part of the state, or, approximately speaking, in 43° .05′ N. lat., and 43° 25′ W. long. In a direct line it is a little more than sixty miles from Fort Klamath. It is a small lake, not over twelve miles long by some eight or nine wide. Fresh water passes into it from Silver Creek over a swampy delta near its northwestern extremity, and a smaller stream of pure water enters it from the westward. The topography of the country about it, as well as the geology of the vicinity, is interesting, and the fauna will well repay the further investigation of the naturalist. So far as at present known, there is but one species of fish that occurs in this lake, *Mylo-leucus formosus* of Girard, one of the Cyprinidæ. Numerous species of aquatic birds are found in numbers on the lake, and frequent its limiting shores and marshes. Chief among these are the swans and geese, the pelicans and the cormorants. *Æchmophorus occidentalis*, the western grebe, represents one of the constantly present podicipidine forms found upon this sheet of water; and there they may be

[1] Read before the Biological Society of Washington, March 21st, 1891.

seen at any time of the day, either singly or in pairs. Probably, although I have no authority for it, the larger waders and several species of the limicoline birds are also to be found upon the shores of Silver Lake during the vernal and autumnal migrations.

At various distances, and in nearly all directions from it, are to be found a number of other lakes more or less like the one we have been considering, though in most instances larger than it, as in the case of Abert's Lake, found some forty-five miles to the southward and eastward.

In the Oregon desert, about forty miles east of Silver Lake, lies Fossil Lake, so named from the rich deposit of fossil mammals, birds, fish, and so forth that have been found there. This lake has long since dried up, though water may yet be obtained by digging, and that at a depth of two feet or more, anywhere over its former bottom. This latter is a perfect mine of wealth for the paleontologist, as it is absolutely filled with the fossil remains of many of the former inhabitants of, or animals that resorted to, what at one time must have been a sheet of water considerably like Silver Lake. Unfortunately for science, when the cattle men first went into that country they gathered up as objects of curiosity the majority of the best fossils of this locality, and they have thus been forever lost to us. This will account, I think, for nearly the entire absence of bird skulls among that kind of material subsequently obtained there by naturalists.

Professor Thomas Condon, of the University of Oregon, was the first scientific man that visited Fossil Lake, and he made a very carefully selected and highly valuable collection there; and some of the fossil birds found by him are now in my hands for description. A few years afterwards, Professor Cope despatched one of his assistants there, Mr. Chas. H. Sternberg, of Lawrence, Kansas, who made an enormous collection on the same ground. Later, in the '80's, Professor Cope visited the region in person, and made another fine collection, including many forms previously found by both Professor Condon and Mr. Sternberg.

In the November number, 1889, of the AMERICAN NATURALIST, Professor Cope, in an article entitled "The Silver Lake of Oregon and Its Region," to which I am indebted for the information above recited, presents us with some of the results of his eminently important researches in that country.

Setting aside the mammals and other vertebrates, it is my intention to say only a few words here about the collection of fossil birds that were obtained by the authorities mentioned.

After these latter were safely transferred east by their distinguished

owner and deposited in his cabinets, he, in various scientific publications, described a number of them. They were the following species, viz.: Two forms of Podiceps, *P. occidentalis* and *P. californicus*, the first-named Professor Cope believing to be identical with the now-existing *Æchmophorus occidentalis* of that region, a species referred to above; *Podilymbus podiceps*, *Graculus macropus* s. n., *Anser hypsibatus* s. n., *canadensis*, *albifrons gambeli*, and another species near *Anser nigricans*; also a swan, which he named *Cygnus paloregonus*, and finally the fossil remains of *Fulica americana*. There were many other species still remaining, and a few years afterwards—that is, early in the present year—Professor Cope did me the honor to pass all this material into my hands for full description and illustration. Coming, as it does, just as I am about to undertake that volume of my "Osteology of the Birds of the United States" which has to deal with the water birds, now in course of preparation, this material is especially welcome to me, as the fossil forms can be conveniently compared with the existing species of birds which I shall describe in that work.

This beautiful collection of fossils consists of some fifteen hundred or more specimens of bones, many of which are perfect, many of which can be restored, and many fragmentary pieces.[2] They are all perfectly clean, the vast majority of them being of a deep leaden hue, almost black in some instances, and exhibit their characters admirably. My preliminary examination of this material leads me to believe that there are still over twenty species of fossil birds represented by it which still remain to be described. This is interesting in view of the fact that up to the present time there have been less than fifty fossil birds of the United States described by naturalists. As we all know, they constitute the rarest of all vertebrate fossil remains. So far as the birds are concerned, when the chapter is written and printed on the Equus beds of Fossil Lake, of later Tertiary times, it may prove that some of those forms still exist; others are undoubtedly extinct; while the general character of the whole agrees with forms that go to make up the existing avifauna of that region. But a close study of the departures therefrom is of the highest importance, and it is rendered the more interesting from the fact that we can compare it with the mammalian, reptilian, and icthyian faunæ of the same horizon. I find that some of these bones must have belonged to rather remarkable types of birds, and different from anything now in existence. They were all found either on or in the loose, friable deposit, the sedimentary

[2] The writer here exhibited some fine selected specimens from the collection, and submitted them to the members of the society present for their examination.

remains of the former bottom of the lake. Furthermore, such comparative studies of this material as a whole is enhanced by the discovery of other relics found commingled with it. Of this Professor Cope has said that "Scattered everywhere in the deposit were the obsidian implements of human manufacture. Some of these were of inferior, others of superior workmanship, and many of them were covered with a pätine of no great thickness, which completely replaced the natural lustre of the surface. Other specimens were as bright as when first made. The abundance of these flints was remarkable, and suggested that they had been shot at the game, both winged and otherwise, that had in former times frequented the lake. Their general absence from the soil of the surrounding region added strength to this supposition. Of course it was impossible to prove the contemporaneity of the flints with animals with whose bones they were mingled, under the circumstances of the mobility of the stratum in which they all occurred. But had they been other than human flints, no question as to their contemporaneity would have arisen. . . . . The probability of the association is, however, greatly increased by the discovery, by Mr. Wm. Taylor, of paleolithic flints in beds of corresponding age, on the San Diego Creek, Texas."[3]

Should, in the future, sufficient evidence come to light to establish any such theory as this, then there will indeed be opened to us another important and interesting chapter upon the paleontologic history of man.—R. W. SHUFELDT, *Takoma Park, D. C.*

Flora of the Great Falls Coal Field, Montana.—Prof. J. S. Newberry gives an interesting account of this flora in the *American Journal of Science*, XLI., March, 1891. A number of specimens were submitted to him for examination, which he found without exception to be species described by Sir Wm. Dawson from the Kootanie Group, Canada, or by Prof. Heer from the Kome Group, Greenland. Further examination by Prof. Fontaine showed them to be also identical with fossils of the Potomac formation. This proves conclusively the general identity of the geological horizons of these four groups, and confirms the view that the Potomac group is Lower Cretaceous, and not Jurassic. A comparison with the Old World forms leads Prof. Newberry to assert that the Potomac, the Kootanie, and the Kome groups represent perhaps distinct but closely related epochs of the Neocomian or Lower Cretaceous of the Old World.

The paper closes with a brief description of the new species: *Chiropteris williamsii*, *Chiropteris spatulata*, *Zamites apertus*, *Baiera*

[3] AMERICAN NATURALIST, Nov., 1889, pp. 979, 980.

brevifolia, Chadophlebis augustifolia, Sequoia acutifolia, Podzamites nervosa, and Oleandra artica Heer.

Secular Disintegration of Rocks.—In a recent paper Mr. Raphael Pumpelly insists that the recognition of the importance of secular disintegration is essential to the proper interpretation of some of the most difficult points in the study of the crystalline schists. It gives a key to the problem in the Green Mountains, N. H. He instances Iron Mountain, Mo., as a convincing illustration of a deep-reaching disintegration in pre-Silurian time, in a region which has not been folded. A mantle of disintegrated rock would be easily and quickly removed by the breaching action of the advancing sea line. "If we substitute this process in each period for the accepted one of slow erosion and breaching of hard rock, we shall," says the writer, "have to materially reconsider our time scales, in so far as they depend upon the rate of accumulation of detrital materials." (Bull. Am. Geol. Soc., Vol. II.)

The Origin of the Bahama Islands.—A careful study of the geography and geology of the Bahamas leads Dr. Northrop to declare himself in favor of a theory of elevation of these islands, instead of subsidence. The main facts that bear on the question of the most recent movement are as follows:

1. The soft calcareous mud on the west coast of Andros grows gradually harder and harder toward inland.

2. The depth of the fine calcareous deposit close to shore.

3. The extension of the pine forest.

4. Mangroves were found high above water-mark apparently dying, but none were seen in situations that indicated that the water was becoming too deep for them.

Note was taken of the extensive erosion of both the surface and the shore line of the islands. (Trans. N. Y. Acad. Sciences, Oct. 13, 1890.)

Geological News. — General. — In a recent paper on the "Resources of the Black Hills," Mr. Robert T. Hill says that this region is certainly capable of supporting a large and prosperous population. Aside from its agricultural resources and scenic beauty, it possesses bituminous coal and coke of good quality, lubricating and illuminating oil, with a possibility of natural gas, ores of precious metals, and of iron, copper, and tin. (Am. Inst. Mining Engineers, Sept., 1890.)

Paleozoic.—Prof. Alexander Winchell calls attention to some Canadian rocks in the vicinity of Echo Lake. They consist of rugged

strata standing vertically, with a strike east,—a discordance of stratification with the Huronian beds, which dip at an angle of 20°, with a strike mostly northeast and southwest. He is convinced of their identity with the vertical strata in Minnesota, and the Kewatin system. Also, they are the prolongation of the "Lower Slate Conglomerate" of the Thessalon valley. (*Am. Geol.*, Dec., 1890).——Charles Proiser has examined the records of drilling in western central New York, and from these well sections has compiled a general section giving the thickness of the different geological formations, together with the total thickness of the series from the lowest Coal Measures down to the Archean. The results show that the thickness of these formations has been greatly underestimated. (*Am. Geol.*, Oct., 1890.)——Messrs. H. R. Geiger and Arthur Keith have worked out the structure of the Blue Ridge near Harper's Ferry, and refer the disputed sandstones to the Upper Silurian. (Bull. Am. Geol. Soc., Vol. II., pp. 155–164.) ——The recent studies of C. Willard Hayes in the Southern Appalachians have shown a modification of the well-recognized types of *unsymmetrical fold* and the *reversed fault*, namely, broad *overthrust faults* which, as developed in Northwestern Georgia, are comparable in magnitude with those of the Scottish Highlands and the Rocky Mountains, as described by Geikie and McConnell. (Bull. Am. Geol. Soc., Vol. II., pp. 141–154).——An Ordovician chert has been found in the Llandeilo-Caradoc rocks of South Scotland, which is considered by G. J. Hinde to be due to an accumulation of the tests of Radiolaria. The beds of fine-grained red and green mudstones associated with the chert favor the view of a deep-sea origin. Mr. Hinde has described twenty-five new species from this rock, referable to fifteen genera, for the most part also new. (*Ann. and Mag. Nat. Hist.*, July, 1890.)——Mr. A. Winslow states that the flexing of the strata in the coal region of Western Arkansas is essentially Appalachian. A study of the various flexures reveals many features which call for compression and lateral movement, and this movement was from the south. The date of elevation must have been post-Carboniferous and pre-Mesozoic. (Bull. Am. Geol. Soc., Vol. II., pp. 225–242.)——According to Eugene A. Smith, the Alabama Coal Measures have an aggregate thickness of 5,525 feet. They are characterized by the small amount of sulphur, by an almost entire absence of limestone, and by having a conglomerate at the top of the series. (Alabama Geol. Survey, 1890.)——Mr. A. C. Seward agrees with Dr. Stur that Asterophyllites and Sphenophyllum are parts of the same plant. This idea was first suggested in 1853 by Newberry, who stated at that time that the difference between

the wedge-shaped and filiform leaves on the same plant was due to emergence and submergence. Newberry's explanation was subsequently adopted by Colemans and Kickx. (Journ. Cin. Soc. Nat. Hist., Jan., 1891.)

Mesozoic.—Mr. Otto Lerch has made a further study of the beds between the Lower Cretacic, the Trinity sands of R. T. Hill, and the Permian, a few miles west of San Angelo, Texas, and concludes that they are pre-Cretacic and post-Permian, and probably may be the continuation and southward thinning out of the Jura and Trias. (*Am. Geol.*, Feb., 1891.)——The Report of the Yorkshire Philosophical Society, 1888, contains a description of a head of *Hybodus delabechei* from the Lower Lias of Lyme Regis, Dorsetshire, England, by A. Smith Woodward, in which he says that the teeth of the Wealden species differ so much from those of the Liassic that possibly this later Mesozoic shark may eventually prove to pertain to a distinct genus. ——In discussing the economic features of the Cretaceous rocks of Texas, Mr. R. T. Hill urges the necessity of recognizing the chalky formations of Texas as a distinct geographic region of the United States. This individuality must be recognized, and the economic development based thereon, instead of the conditions of entirely different non-chalky regions. The agricultural experience of northern and eastern states will not apply to these soils, but we must go to the chalky regions of France and England, where there are analogous formations, to learn for what they are best adapted. This region is especially rich in mineral fertilizers, and there is a great variety and abundance of building material. Owing to the slightly disturbed conditions of the formations, the district east of the Pecos is not a profitable field for the search of metallic minerals. (Report Texas Geol. Survey, 1889.)——A. Smith Woodward has figured and described two groups of teeth of the Cretaceous Selachian fish Ptychodus found in the English chalk. (Ann. Rept. Yorkshire Phil. Soc., 1889.)——Montagu Browne has revised the genus Dapedius,—a group of fossil fishes not far removed from Lepidotidæ. (Trans. Leicester Lit. and Philos. Soc., Oct., 1890.)——A study of the Shasta Group leads Mr. George Becker to conclude that the conditions and associations on the British Pacific coast appear to correspond completely with those in the United States so far as the Aucella beds are concerned, and the present indications are that all of them are to be regarded as equivalent to the Gault. (Bull. Am. Geol. Soc., Vol. II., pp. 201–208.)——The newly opened oil field of Colorado is located in the valley of the Arkansas, between Pueblo and Cañon City. At

present its limits are undetermined. The bituminous shales of the Colorado group, which are evidently the source of the oil, underlie a wide belt of country along the eastern base of the Rocky Mountains. Along this zone, intermediate between the mountains and plains, oil fields will probably be found in places where the shales have been somewhat affected by the proximity of the crystalline rocks, and yet have not been too much disturbed and broken. (Prof. J. S. Newberry, *School of Mines Quart.*, Vol. X., January, 1889.)——In a recent paper, Prof. Angelo Heilprin has presented the leading facts touching the geological and paleontological relations of the Cretaceous deposits of Mexico. These deposits cover, or are scattered over, the greatest part of Mexico, from the Rio Grande to (or through) the states of Colima, Michoacan, Guerero, and Oaxaca. (Proc. Acad. Nat. Sciences, Phila., Dec., 1890.)

Cenozoic.—R. Lydekker has collected circumstantial evidence which justifies him in regarding the so-called genus Sceparnodon as based upon the upper incisors of the gigantic wombat known as Phascolonus. (Proc. Roy. Soc., Vol. 49.)——Mr. George Becker has published new evidence in favor of the authenticity of the Calaveras skull, and amply sufficient of itself to prove that man existed during the auriferous gravel period in California. He has the sworn statement of John H. Neale of the discovery of a mortar and pestle and some spear-heads, in place, in the gravel underlying the lava of Table Mountain. He also records the discovery, by Mr. Clarence King, of a polished stone implement from the same locality. The character of the tools found, which indicate a high stage of development, and their association with an extinct fauna, incline some students to discredit the discoveries. Mr. Becker suggests the reasonable hypothesis that a local glaciation of the Sierra, confined to limits later than what is known as the Glacial epoch, may be made to account for the extraordinary association of neolithic implements with Pliocene bones in California. (Bull. Am. Geol. Soc., Vol. II., pp. 189–200.)——In discussing facts bearing upon the pre-Glacial drainage of Western Pennsylvania, M. P. Foshay thinks the conclusion imperative that this area must have drained northwardly into the Erie basin. This ancient basin would then include the areas now drained by the Lower Allegheny, Clarion, Redbank, Mahoning, Conemaugh, Youghiogheny, Cheat, Monongahela, and Little Beaver rivers. (*Am. Journ. Science*, Vol. XL., Nov., 1890.)——In describing the eruption of a volcano on the island of St. Vincent, W. I., Dr. Benjamin Sharp says that the mass of material thrown out from this single vent relieved an area of

the earth's crust nearly as large as that of Europe. Volcanic dust fell on an island ninety-five miles to the windward in such quantities that trees were crushed to the earth by the weight of its mass. During the eruption subterranean noises were heard at Caracas, and in the midst of the Llanos, which cover a space of 36,000 square miles. (Proc. Phila. Acad. Nat. Science, 1890.)

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—The protogine of Mont Blanc is shown by Lévy[2] to be a true eruptive, apophyses from which penetrate the surrounding schists and alter them, and break from them fragments which they hold as inclusions. These fragments have been regarded as basic segregations, and the surrounding schists have been looked upon as dynamo-metamorphosed phases of the protogine. Both of these views the author combats. Among the schists he finds eclogites, with diopside in micropegmatitic intergrowths with quartz and feldspar, amphibolites and mica-schists, each of which classes is briefly described. The segregations mentioned occur most frequently near the contact of the granite with the schists. Many of them resemble so closely certain phases of the schists that Lévy is compelled to regard them as fragments of these caught up by the eruptive during its passage from below. A microgranite from the periphery of the main mass of granite consists of corroded crystals of the first generation cemented by a granitic ground-mass. This fact is thought to be an indication of the correctness of the view that the constituents of granite are mainly of the second generation, those of the first consolidation having disappeared. To the southeast of Mont Blanc are quartz-porphyries which, according to Graeff,[3] are genetically related to the granite composing the body of the mountain. Like the latter, the porphyries have been subjected to pressure, by which process much sericite has been developed, resulting in sericite-schists. The present contact of the eruptives with the gneisses and mica-schists of the Mont Blanc "massif" is thought not to be an original contact, but one brought about by dislocations. The conclusions of Lévy and Graeff are thus seen to be in accord in some particulars, while in others they are at variance. Fuller discussions are promised later.——In the first part of a general

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] Bull. des Serv. d. l. Carte. gèol. d. la France, No. 9, 1890.

[3] Archiv. des Sciences phys. et nat., Nov., 1890.

sketch of the geology of the Japanese Islands Harada[4] gives short descriptions of Archean gneisses and schists, and of eruptive rocks of more recent age. Among the schists are mentioned graphitic sericite-schists, with well-developed crystals of tourmaline and hematite, and a chloritic amphibolite whose principal feldspar is albite. Gabbros and peridotites cut the Paleozoic strata. In some specimens of the former piedmontite was noticed as an alteration product of hornblende. In the Mesozoic occurs the largest quantity of eruptives. Granite and diorite in many varieties cut through the sedimentary rocks, and change them near the contact into hornstones holding cordierite and ottrelite. In sericite-gneiss garnets are produced, in amphibolites andalusite is a new product, and in limestone wollastonite and garnet result from the contact action. The eruptives, on the other hand, become coarse-grained and porphyritic near the contact, the diorite losing hornblende and gaining quartz and orthoclase, until it finally resembles a granite. Among the effusives of this age are mentioned quartz-porphyries and porphyrites.——Weinschenck[5] communicates additional information with respect to the rocks of these islands, as a result of the study of some hand specimens. Most of the sections examined by him are of a hypersthene andesite, with a plagioclase full of inclusions, and a pleochroic monoclinic pyroxene which sometimes forms intergrowths with hypersthene. Among the rocks from the extinct volcanoes is a bronzite trachyte containing biotite, garnet, and tridymite in a ground-mass of the same minerals and zircon, in a trichitic glass. The most interesting rock of the series bears the same relation to the andesites as the augitites do to the basalts. It consists principally of acicular crystals of bronzite in a ground-mass consisting of clear glass and magnetite grains, with porphyritic plagioclase and garnets. The author calls the rock *sanukite*, from the province in which it is found.

Mineralogical News.—The regular silicates are very few in number, and of them eight are orthosilicates,—viz., *eulytite*, *zunyite*, *helvite*, *danalite*, *garnet*, *sodalite*, *nosean* and *hauyne*, and *lasurite*. These Brögger and Backström[6] would include in one group, which they would call the garnet group. The members of this group is divided into two sub-groups, in one of which the tetrahedral habit is predominant and the cleavage is octahedral. This includes the first four minerals mentioned above, and is known as the helvite group. All its members can be represented by formulas of the garnet type. Helvite may be

[4] Die Japanischen Inseln., 1st Lief., Berlin, Parey, 1890.

[5] *Neues Jahrb. f. Min.*, etc., B. B. VII., p. 133.

[6] *Zeits. f. Kryst.*, XVIII., 1890, p. 209.

written $(MnFeCa)_2(Mn_2S)Be_3(SiO_4)_3$, danalite as $(FeZnMn)_2[(ZnFe)_2S]Be_3(SiO_4)_3$, zunyite as $[(OH)_9Fe_2ClAl_6](SiO_4)_3$, and eulytite as $Bi_4(SiO_4)_3$. The second sub-group includes the species with with dodecahedral habit and cleavage. Embraced in this is the garnet series proper, with a composition $R_3^{II} R_2^{III} (SiO_4)_3$, and the series of the alkaline garnets. The etched figures on the latter indicate that they are all tetrahedrally hemihedral, and a discussion of the best analysis of them leads to the conclusion that they are all of the chemical type of common garnet. Sodalite is $Na_4(AlCl)Al_2(SiO_4)_3$ and nosean is $Na_4[Al(NaSO_4)]Al_2(SiO_4)_3$. In hauyne, calcium replaces some of the sodium in nosean. Lapis-lazuli, or natural ultramarine, is a mixture of several minerals, of which one is bright blue. The authors have isolated this and found it to contain:

SiO_2	Al_2O_3	CaO	Na_2O	K_2O	SO_3	S	Cl
32.52	27.61	6.47	19.45	.28	10.46	2.71	.47

Upon the assumption that this is a mixture of hauyne, sodalite, and ultramarine, it is calculated that the latter substance must be represented by the formula $Na_4[Al(S_3Na)]Al_2(SiO_4)_3$. The authors then discuss the nature of artificial ultramarine, and conclude that it is a mixture of five isomorphous substances. A microscopical examination of lapis-lazuli reveals the fact that in all cases this is a mixture of several substances, among which may be mentioned hauyne, diopside, kokscharowite, calcite, pyrite, and a muscovite-like mineral, together with a little scapolite, plagioclase, orthoclase, apatite, sphene, zircon, and an unknown, probably positive, uniaxial mineral.——The interesting Chilian minerals continue to be subjects of investigation to those who are fortunate enough to come into possession of them. Frenzel[7] describes briefly a few of the rarer among them. *Sideronatrite*, with a yellow color and a metallic lustre, has a density of 2.31, and a composition as follows:

$$\begin{array}{cccc} SO_3 & Fe_2O_3 & Na_2O & H_2O \\ 42.93 & 22.86 & 17.49 & 15.66 \end{array} = 2Na_2SO_4 + Fe_2S_2O_9 + 6H_2O$$

The mineral is from Sierra Gorda, near Caracoles. It is identical with the Peruvian sideronatrite described by Raimond,[8] which, however, was regarded by him as possessing but one molecule of Na_2SO_4 to one of the iron sulphate. It is probably an alteration product of *hohmannite*, occurring associated with it, and found also in the Sierra de la Caparrosa, as brownish-red, glassy plates and crystals, often arranged in radial aggregates. Their hardness is 3, and specific gravity 2.17.

[7] *Miner. u. Petrog. Mitth.*, XI., 1890, p. 214.

[8] *Zeits. f. Kryst.*, 1882, VI., p. 627.

They remain unchanged in the air, and have the same composition as amarantite and the specimens of hohmantite[9] analyzed a short time since,—viz., $Fe_2S_2O_9+7H_2O$. Various other minerals from the same region are briefly alluded to in this paper, and two new ones (quetenite and gordaite)[10] are described. Messrs. Genth and Penfield[11] have examined some of these species in more detail. The material in their possession is from the Mina de la Campania, near Sierra Gordo. *Amarantite* is found to be triclinic with $a:b:c = .76915:1:.57383$ $\alpha = 95° 38' 16''$, $\beta = 90° 23' 42''$, $\gamma = 97° 13' 4''$. The habit of the crystals is prismatic. The brachy, and macropinacoids are vertically striated, and a perfect cleavage is parallel to each. The optical angle $2E^{na} = 63° 3'$, and the extinction in the macropinacoid is 16°–17°, in acute β. Fibres of *sideronatrite* show a slight pleochroism, with a pale straw-yellow color parallel to the longer axis, and no color at right angles to this. The formula ascribed to the substance differs from Frenzel's formula in lacking one molecule of water. *Ferronatrite*, although obtainable only in white or grayish cleavage masses, is thought to be hexagonal. Its indices of refraction are $\omega = 1.558$, $\varepsilon = 1.613$, and its composition is $SO_3 = 51.30$; $Fe_2O_3 = 17.30$; $Na_2O = 19.95$; $H_2O = 11.89$; specific gravity $= 2.547–2.578$. Darapsky[12] also gives a few notes of observations on a few of the minerals from Atacama. Among these are *aromite, paposite, amarantite, hohmannite, coquimbite, fibroferrite, nebrite, botryogen, thenardite, quartz*, and *halite*.—— Bauer[13] describes the first interpenetration twin of *tourmaline*, from an unknown locality. The twinning plane is R, and the forms observed in the individuals are $\infty P2$ and $-2R$. A pseudomorph of *aragonite* after calcite, from Müsen in Siegen, is one of the few instanesc described in which the latter mineral is known to have changed into the former one. They consist of shells of calcite enclosing a white granular calcite holding crystals of barite and snow-white aragonite. These fill two-thirds of the space within the shell, the remaining one-third being hollow. The pseudomorph is supposed to be due not to the molecular replacement of the calcite, but to solution of the interior of the crystal and subsequent deposition of calcium carbonate from calcium-bearing solutions containing traces of barium. By experimentation Bauer has found that barium bearing calcium carbonate solu-

[9] *Miner. u. Petrog. Mitth.*, IX., p. 397.

[10] AMERICAN NATURALIST, Dec., p. 1190.

[11] *Amer. Jour. Sci.*, Sep., 1890, p. 199.

[12] *Neues Jahrb. f. Min.*, etc., 1890, I., p. 49.

[13] *Neues Jahrb. f. Min.*, etc., 1890, I., p. 10.

tions deposit crystals with the properties of aragonite. The crystals of *lievrite*, from Dillenburg, Nassau, fall into two classes. The first includes well-developed prismatic forms with large macrodomes ($\bar{P}\infty$) on both terminations. The others are prismatic with $\bar{P}4o$ and $\bar{P}\frac{28}{25}$ on one termination. The other is attached to the gangue. Their axial ratio is .6795 : 1 : .4576. In the article by Messrs. Genth and Penfield [14] referred to above appear analyses of *picropharmacolite* from Joplin, Mo., of a substance supposed to be ———— from near Georgetown, N. M.; of *pitticite* from the Clarissa Mine, in the Tintic District, Utah; and of *gibbsite* from White Horn Station, Chester Co., Pa. The last-named mineral is discovered to be a hydrous aluminium phosphate. The pitticite corresponds in composition to $4Fe_2As_2O_8\ Fe_2(OH)_6+20H_2O$.——The remarkable mineral locality, Branchville. has again been reported upon by Messrs. Brush and Dana.[15] During the ten years that have elapsed since their previous report [16] extensive mining has been carried on at the locality for the purpose of obtaining quartz and microcline for technical uses. During the past two years large quantities of rare magnesian phosphates have been brought to light, and these have been investigated by the mineralogists mentioned. The minerals whose indentification is recorded are *lithiophilite*, *hureaulite*, *reddingite*, *fairfieldite*, *dickinsonite*, and *fillowite*. The lithiophilite is in rudely crystalline masses in a vein, associated with albite, quartz, and spodumene. It is, as a rule, fresh. Occasionally it is extensively altered into hureaulite through the intermediate product dickinsonite. The succession in age of its various decomposition products, among which are all the other minerals mentioned above, could not be determined, as they seem to occur together promiscuously. The hureaulite, heretofore known only at Limoges, France, is in small monoclinic crystals, varying in color from violet to orange red, and united into parallel aggregates. Their axial ratio is $a:b:c=1.9192:1:.5245$ with $\beta=84°\ 1'$, on the assumption of the plane $\frac{4}{5}\bar{P}\frac{4}{3}$, determined by Descloizeaux in the Limoges crystals as the ground form. The habit of the Branchville crystals is short prismatic, with $\infty\bar{P}\infty$ and various pyramids well developed. The crystals have a good cleavage parallel to the orthopinacoid, a specific gravity of 3.149, and a composition as follows:

P_2O_5	FeO	MnO	CaO	H_2O	Quartz.
38.36	4.56	42.29	.94	12.20	1.76

[14] *Amer. Jour. Sci.*, Sep., 1890, p. 199.

[15] *Amer. Jour. Sci.*, Mch., 1890, p. 201.

[16] Ib., 1880, p. 257.

corresponding to $H_2(MnFeCa)_5PO_4+4H_2O$. Reddingite is in pinkish-white masses, and in orthorhombic crystals with an octahedral habit. The axial ratio is $a:b:c=.8678:1:.9485$, and density 3.204. Their analysis yielded Mr. Wells:

P_2O_5	FeO	MnO	CaO	H_2O	Quartz.
34.90	17.13	34.51	.63	13.18	.13

a result expressed by the formula $(FeMn)_3(PO_4)_2+3H_2O$. Fairfieldite is in transparent foliated masses of a whitish or greenish-white color and a brilliant lustre, inclining to pearly on the perfect cleavage. Its composition agrees with the symbol $Ca_2Mn(PO_4)_2+2H_2O$. Dickinsonite is a bright green chlorite-like mineral with a micaceous structure and rhombic tabular habit.——The beautiful *chalcopyrite* [17] crystals from the French Creek Mines, Chester Co., Pa., occur together with pyrite [18] imbedded in byssolite, thuringite, and calcite in pockets in a magnetic iron ore. The principal type of the chalcopyrite is the sphenoid $\frac{\frac{3}{2}P}{2}$ often modified by a scalenohedron. All the faces are striated, and frequently they are so much rounded as to preclude measurements of their interfacial angles. Twinned crystals are quite common, the combination possessing an hexagonal habit.——The rare zeolite *mordenite* has been discovered by Pirsson [19] in the cavity of an amygdaloidal basalt, forming fragments in a breccia near Hoodoo Mt. in Western Wyoming. The mineral is in very small crystals, with a specific gravity lying between 2.119 and 2.179. Their analysis yields:

SiO_2	Al_2O_3	FeO_3	CaO	MgO	K_2O	Na_2O	H_2O
66.40	11.17	.57	1.94	.17	3.58	2.27	13.31

which is equivalent to $3RAl_2Si_{10}O_{24}+20H_2O$, in which R represents potassium, sodium, and calcium. The mineral differs from ptilolite in containing more water. In crystallization it is monoclinic, and is isomorphous with heulandite. Its habit resembles that of beaumontite. $a:b:c=.4010:1:.4262$, $\beta=88°\ 30.5'$. The plane of the optical axes is perpendicular to $\infty P\grave{\infty}$, and the extinction on this face is 15° to the clino-axis.——A careful examination of the *apophyllite* of the Seiser Alps indicates to Ploner [20] that the differences in the lengths of the crystallographic axes of specimens of the minerals from different localities, and occasionally even in different parts of the same individual, are due to variations in the positions of planes to which identical symbols have been given. The new forms detected on the crystals

[17] Penfield. *Amer. Jour. Sci.*, Sep., 1890, p. 207.

[18] Penfield. Ib., III., XXXVII., p. 209.

[19] Ib., Sep., 1890, p. 232.

[20] *Zeits. f. Kryst.* XVIII., 1890, p. 337.

examined are $\frac{1}{10}P$, $\frac{1}{5}P$, $\frac{2}{7}P$, ∞P, $P\infty$, $\frac{5}{3}P\infty$, $\frac{1}{2}P\frac{3}{2}$, $3P\frac{3}{2}$, $\infty P2$, and $\infty P3$, making ninety-seven forms now known to occur in the species.——Baumhauer[21] has discovered some small but good crystals of *cryolite* in a hand specimen from Evigtok, Greenland, so twinned that both individuals have their basal planes in common, and one appears to have been revolved about 88° 2′ around an axis normal to the base.——The limestone of Villefranque and of Biarritz, France, contains long needles of quartz and crystals of dipyr and albite,[22] the first of which must have been formed contemporaneously with the limestone, while the last two were produced by the influence of an intrusive mass of diabase upon the enclosing rock.——Traube[23] ascribes the differences in the values of the axial ratios of different *sheelites* to the amounts of molybdenum occurring in them. Analyses of many specimens reveal the fact that white and light yellow varities contain but little of this element, while the dark varieties contain quite large amounts, (1–8%). The axial ratio of the purest scheelite is 1 : 1.5315, that of calcium molybdenate is 1 : 1.5458, and that of most scheelites between these limits.——In the pegmatite veins cutting granite near Meissen, Saxony, Sauer and Ussing[24] have found Baveno twins of *microcline* in which the gridiron structure is lacking. Lamellæ of albite are intergrown with the microcline, but sufficiently large areas of the latter mineral were found to allow of careful measurements of cleavage, angles, etc. The angle between the cleavage lines is 89° 30′, and the refractive indices for sodium light $\alpha = 1.5224$, $\beta = 1.5264$, $\gamma = 1.5295$. The optical angle is $2V = 83° 41'$.——A pure white *zinc sulphide* is mentioned by Mr. Robertson[25] as occurring at Galena, Cherokee Co., Kansas. It is associated with sphalerite, and is in a form suggesting the moist, freshly prepared substance. It is saturated with water bearing a trace of sulphuric acid. Its composition is: $Zn = 63.70$; $S = 30.77$; $Fe_2O_3 = 2.40$; Insol. $= 2.52$.——Rinne[26] gives some good illustrations of *microcline* structure in the feldspar of the Stockholm granite and of the Kyffhäuser gneiss, and suggests reasons for regarding it as a secondary phenomenon produced in non-striated feldspar.——The *phenacite* reported by Mr. Yeates[27] from

[21] Ib., XVIII., 1890, p. 355.

[22] Beaugey. Bull. Soc. Franc. d. Min., XIII., Feb., 1890, p. 59.

[23] *Neues Jahrb. f. Min.*, etc., B. B. VII., p. 232.

[24] *Zeits. f. Kryst.*, XVIII., 1890, p. 192.

[25] *Amer. Jour. Sci.*, Aug., 1890, p. 161.

[26] *Neues. Jahrb. f. Min.*, etc., 1890, II., p. 66.

[27] *Amer. Jour. Sci.*, Sep., 1890, p. 259.

Hebron, Me., turns out upon analysis to be apatite with a tabular habit.

New Minerals.—A new borate has been discovered imbedded in the form of small, colorless, transparent, or milky-white crystals in the pinnolite of Stassfurt, Germany. The crystals are monoclinic, with two perfect cleavages perpendicular to the plane of symmetry. One of these is assumed as the base, and the other as the orthopinacoid, when the axial ratio becomes $a:b:c = 2.1937:1:1.73385$; $\beta = 80°$ $12'$. The forms observed are $\infty\bar{P}\infty$, ∞P, $-P$, $\frac{1}{2}P$, $\bar{P}\infty$, and $-3\bar{P}3$. Hardness is 4–5; density, 2.127. The plane of the optical axes is perpendicular to the plane of symmetry, and makes with c an angle of $7°$ in acute β. $A = b$. $2H_{na} = 104° \, 27'$. The composition of the substance, as found by Baurath, is:

B_2O_3	MgO	K_2O	Na_2O	Cl	H_2O
52.13	13.80	8.14	.39	.35	23.83

which corresponds to $H_4Mg_2K(BO_2)_9+6H_2O$. The name Hintzeite has been given it by Milch.[28] The same mineral is described under the name Heintzite by Leudecke.[29] According to this investigator, the mineral is easily soluble in hydrochloric and nitric acids. An analysis yielded results different from those above given, as follows: $B_2O_3 = 60.53$; $MgO = 12.23$; $K_2O = 7.39$; $H_2O = 19.85$. The axes chosen by Leudecke have the ratios $a:b:c = 1.2912:1:1.7572$ $\beta: 57° \, 41' \, 4$. The principal cleavages are thus parallel to oP and to $\frac{1}{2}P\infty$. The refractive index for sodium light vibrating parallel to A is 1.354. The other optical properties coincide with those determined by Milch. Prof. Groth suggests that neither of the two names suggested for the mineral be accepted until it is found which analysis is correct.——*Powellite.*—In a weathered fragment of bornite from the Devil's Mining Region, in Idaho, Mr. Melville[30] has discovered a mineral resembling scheelite in external appearance, but differing from it in composition. The crystals are small, prismatic, greenish-yellow in color, with a hardness of 3.5, and a density of 4.526. They have a resinous lustre, and are semi-transparent and brittle. Measurements of angles indicate a tetragonal symmetry with $a:c = 1:1.5445$. The planes appearing oP, P, $P\infty$, and ∞P. The composition is:

MoO_3	WO_3	SiO_2	CuO	MgO	Fe_2O_3	Al_2O_3	CuO	S
58.58	10.28	3.25	25.55	.16	1.65	tr.	tr.	und.

[28] *Zeits. f. Kryst.*, XVIII., 1890, p. 479.

[29] Ib., p. 481.

[30] *Amer. Jour. Sci.*, Feb., 1891, p. 141.

The mineral bears the same relation to calcium molybdate as scheelite does to the corresponding tungstate.——An isotropic or weakly doubly refracting mineral occurs in the nepheline-syenite of a "massif" in the Kole Peninsula, Russia. Since its properties have not yet been fully determined, its discoverer, Ramsay,[31] has not yet assigned to it a name. The mineral is red and transparent. It fuses easily, and yields water. It is attacked by acids with difficulty, has a low index of refraction, $n_{na} = 1.5223$, and possesses no cleavage. Its density is 2.753, and composition:

SiO_2	$Al_2O_3Fe_2O_3$	MnO	CuO	MgO	Na_2O	K_2O	Loss
55.88	15.19	2.67	9.53	.53	9.06	1.57	6.04

——*Leverrierite*[32] occurs in small pseudohexagonal prisms that are twinned orthorhombic forms with a prismatic angle of 128°. They have a very perfect cleavage parallel to oP, so that they may easily be mistaken for mica. Often the prisms are twisted so that they resemble worm tubes to such perfection that they have been mistaken for organic markings, and have been described under the name *bacillarites.* According to Termier, all specimens of bacillarites examined by him are prisms of the new mineral whose composition is $H_{10}Al_4Si_5O_{21}$. The hardness of the substance is 1.5, and its density 2.3–2.4. The plane of its optical axes is $\infty\bar{P}\infty$, with a negative acute bisectrix normal to oP and an optical angle $2V = 45°–52°$. It may be distinguished from muscovite by its dark color, and from biotite by its weak pleochroism, and its weak double refraction. Leverrierite is found as a metamorphic constituent in carbonaceous clay slates, and in interstratified carboniferous eruptives.

[31] Ref. *Neues Jahrb. f. Min.*, etc., 1891, I., p. 98.

[32] Bull. Soc. Franc. d. Min., XIII., 1890, p. 325.

BOTANY.

Protoplasmic Physics.—Prof. Pfeffer, of Leipzig, has published [1] the results of his studies on the taking up and extrusion of solid substances by the plasmodia of Myxomycetes, especially of *Chondroderma difforme.* He concludes that, contrary to the more generally accepted view, the inclusion of solid bodies is due not at all to reaction to chemical or contact stimulus, but is a purely mechanical process due to the weight of the body, or to its resistance to the forward movement of the plasmodium. The plasma-membrane closes behind the included object like a film of oil from which a needle is withdrawn.

Indifferent or insoluble substances are not infrequently enclosed in vacuoles, from which they may pass back into the protoplasm; but substances which can furnish nutrient material to the protoplasm are never seen in vacuoles. In from one to four days all foreign bodies are thrown out, even such as are still capable of furnishing abundant nutritive material. Bodies enclosed in vacuoles are thrown out by the rupture of the vacuoles after they have migrated to the margin of the plasmodium. Extrusion of foreign bodies occurs only during the active movementof plasmodia, and is chiefly referable to their resistance to this movement. It is, as yet, wholly impossible to explain why one body follows the movements of the protoplasm, while others are thrown out. In the study of protoplasm within the cell-wall the author observed in the root-hairs of *Trianea bogotensis* that precipitates formed in the cell-sap by the action of methyl-blue were taken up by the protoplasm, as well as crystals of calcium oxalate, and he saw both sorts of bodies returned to the vacuoles. He considers that, in view of the interchange observed, it cannot be regarded as certain that a given element of the cell-contents has arisen where it is seen in any single case.

The same author concludes, in a paper following the last,[2] that vacuoles may arise anywhere in the cytoplasm, not necessarily by division, but independently, in spite of the views of the De Vries school. In the plasmodia of Chondroderma, he has observed all the intermediate conditions between pulsating and inactive vacuoles, and has succeeded by very ingenious experiments in producing vacuoles artificially. This was done by placing a plasmodium in a saturated aqueous solution of asparagin, or some other suitable substance, which contained some

[1] Ueber Aufnahme und Ausgabe ungelöster Körper. Abhandl. d. Math.—Phys. Cl. d. Sächs Ges. de Wissensch. Bd. XVI., p. 149. (Bot. Centralbl., XLIV., 180.)

[2] Zur Kenntniss der Plasmahaut und der Vacuolen, etc.; *l. c.* p. 185. (Bot. Centralb., *l. c.*)

undissolved granules of the same substance. After it had taken up some of these granules the plasmodium was removed to pure water, when a vacuole was slowly formed about each granule, in consequence of its gradual evolution. These artificial vacuoles differed in no respect, except in size, from the natural ones, but even showed, in some cases, slight pulsations. They were seen to divide and to fuse with each other and with pulsating vacuoles, and were formed even in chloroformed plasmodia. It is evident that these vacuoles cannot be dependent on a special organ, the tonoplast of De Vries, for their formation.

Pfeffer considers the hyaloplasm and the granular plasma of the cell protoplasm to be essentially the same, and to differ merely in the presence or absence of granules of most various composition, some of which are foreign substances. He has seen the change from one to the other condition, and has observed the formation of vacuoles in both granular and hyaline plasma. He considers the existence of a plasmamembrane, distinct from the remaining cytoplasm, very probable, in view of the peculiar osmotic phenomena presented by the cytoplast. It is uncertain whether this membrane owes its origin to a definite surface stretching or whether the contact of water is also necessary. Vital activity does not appear to be essential either to its formation or to the manifestation of plasticity in the protoplast.—J. E. HUMPHREY, *Amherst, Mass.*

Alcoholic Material for Laboratory Work in Systematic Botany.—It is now generally recognized that laboratory practice or field work is indispensable to effective instruction in all the natural sciences. Botany deals with material that is especially adapted to training the powers of observation. The translation of the characters of a stem, leaf, or flower into appropriate language will give the student a habit of careful investigation, as well as facility in description.

Plants direct from the field are generally considered to be in the best possible condition for use in the laboratory. It is a difficult matter sometimes, however, to shape courses of instruction so as to have plants in flower just at the time when they are needed. During the spring there is an abundance ; but in the fall and winter, how shall material be provided? To furnish a class of thirty or more from a greenhouse is too expensive ; moreover, plants will not always blossom in the greenhouse just when desired. The plan is sometimes adopted of pressing enough specimens to supply each member of the class with a specimen of the species to be studied. There are serious objections, however, to this plan. In the first place, specimens collected in such a wholesale way are not apt to be satisfactory. All

specimens should be as complete as possible when they are to be used by students. Second, dry material is very difficult to dissect. Soaking in water will soften the tissue, but renders it too soft and pulpy to dissect nicely. A third objection to this plan is the expense of collecting so large an amount of material every year, for, in most cases, at least one specimen will be used up by a student in a single study.

Having experienced the above difficulties in the laboratory, we have been trying in various ways to overcome them. The work of the winter in the laboratory is to make a study of typical species of several orders, among which are the Rosaceæ, Ranunculaceæ, Nymphæaceæ, and Leguminosæ. This work has been preceded by similar studies in the orders Compositæ, Gramineæ, and Cyperaceæ in the fall, and by general work in plant analysis during the previous spring term. The course is accompanied by lectures. Now, instead of pressing as many specimens of each species as is intended for study each year, we pursue the following plan: The species to be studied are selected. As many specimens of each species as there will be students in the laboratory at each session are pressed, taking great pains to have each specimen as complete as possible, and also pressing and drying them promptly, so as to preserve the colors. These specimens are mounted on heavy card-board sheets. A convenient size for the sheets is 14x22 inches. The specimens are fastened to the card-board with fish-glue, or may be fastened with narrow strips of gummed paper; I think the fish-glue is preferable. The mounted specimen shows the whole plant if possible. The fruit is also shown. When the plant is too large to press entire the flower, fruit, various forms of leaves, and a piece of the root and stem are mounted. If the plant has medicinal properties, the part which is medicinal is shown as it appears in commerce. If any part of the plant be of economic importance, as the fibre of flax or the bast of basswood, these are shown.

Such a set of permanent, mounted specimens duplicates plants growing fresh in the field sufficiently for the purposes of systematic study. The cards, when in use, are suspended from an arm by "bull-dog hooks," which may be obtained at any bookstore. The arms are about one foot long, and, as the tables are arranged in our laboratory, can be fastened to the window casing. Very nice horizontal arms with attachment can be obtained of furniture dealers.

To go along with these mounted specimens a sufficient quantity of flowers and young fruits for dissection to supply the class is collected and preserved in alcohol until they are to be used. So far, our experience has been that alcohol is the best preservative for this tissue, as

well as for tissue designed for histological purposes. The fresh material is put in 50 per cent. alcohol, and then the strength of the alcohol is gradually increased until it is at least 80 per cent. A very effective way of hardening is to place the material in a straight glass vessel, such as a straight beaker having a membrane of chamois-skin for a bottom. This is placed in another jar. This makes a vessel within a vessel. The outer one contains 95 per cent. alcohol; the inner contains the material and just sufficient 50 per cent. alcohol to cover it. Gradually the alcohol in the inner vessel will become stronger, until it is sufficiently strong to preserve the tissue. This is Schultze's apparatus. Hardening in this way saves alcohol and time. Where material is changed from weaker to stronger there is always left over a considerable quantity of alcohol too weak to use for permanent storage. Where the Schultze apparatus is used, the spirit in which the material is when hardened is strong enough to preserve it indefinitely. We store our hardened material in ordinary fruit jars. It is perfect in all respects except color, the loss of which is more of an advantage than disadvantage. The tissue is clear and cuts smoothly. By keeping it slightly moistened with the preserving fluid while dissecting, it preserves its shape as long as desired. It is less pulpy than fresh tissue, and much more manageable than dry.

The sets of mounted specimens are permanent, and with careful usage will last a long time. The supply of alcoholic material can be replenished from time to time at slight expense.

It is of great value to have a set of microscopical slides on which are mounted sections of the ovary so cut as to show the insertion of the ovules; also their parts and their arrangement. This is a subject of much importance in the study of systematic botany, and one involved in considerable difficulty. The fresh tissue of ovules is delicate, and by hardening in alcohol, imbedding, and making permanent microscopical mounts, a very profitable and interesting course of study may be arranged. If any teachers have occasion to use specimens for study during the season when flowers are not in bloom, they will find this method worth trying.—W. W. Rowlee, *Cornell University*.

A Field Manual of Botany.—It is announced again that there will soon be issued a special edition of Gray's Manual for field use. It will be printed on thin French paper, with narrow margins. It will be bound in full leather, limp, and cut flush, very much like a foreign guide-book. The price will be two dollars, which is but a trifle more than for the ordinary edition. It will prove a useful book to students and collectors.—Charles E. Bessey.

ZOOLOGY.

Reproduction of Urnatella.—Statoblasts have not hitherto been found in this curious type of the Polyzoa, first described by Leidy. Mr. Edward Potts has lately succeeded in having the animal reproduce itself by germination from the jointed stems which remain after the polyp-heads have died down. "About the middle of September last I gathered from the bed of the Schuylkill canal, below Flat Rock Dam, some sticks bearing colonies of Leidy's Urnatella. The heads as usual soon died; but as no statoblasts have yet been discovered to be produced by this polyzoon, I kept the jointed stems under the impression that they took the place of gemmules and would reproduce themselves in the spring. On February 1st I found them thus rejuvenating themselves, and I now have a good stock of Urnatellas." The preceding is an extract from a note by Mr. Potts to one of the associate editors.—R.

The Growth of Corals.—Alexander Agassiz has figured some specimens of coral, natural size, taken from the shore end of the international cable laid between Havana and Key West. As this portion of the cable was repaired in 1881, these specimens represent a seven years' growth. *Orbicella annularis* shows a greater increase than estimated by Verrill. *Manicina areolata* and *Isophyllia dipsacea* show very rapid increase. (Bull. Harvard Mus. Comp. Zool., Vol. XX., No. 2.)

The Changes of the Salamander Diemyctylus viridescens.—I have now demonstrated the following facts with reference to this Amphibian: 1. The eggs are internally fertilized. 2. The larvæ have the form and coloration of the adult aquatic ones. 3. When the gills are lost the animal becomes terrestial, and changes it viridescent color for red. 4. At maturity the red terrestial form goes into the water, and assumes a viridescent coloration. 5. In aquatic forms, whether adult or larval, the epithelium of the mouth is stratified and non-ciliated. 6. In the terrestrial forms the oral epithelium is ciliated. —Simon H. Gage.

EMBRYOLOGY.[1]

On the Fœtal Membranes of Testudinata.—Dr. K. Mitsukuri has published an elaborate paper in the Journal of the College of Science, Imperial University of Japan (Vol. IV., pt. 1), on the fœtal membranes of the turtle. The contribution is a paper of fifty pages, with ten excellent plates. The amnion arises from an anterior and two lateral folds,—there is no posterior fold,—and these extend gradually from before backwards. The lateral folds meet above the embryo, but their cavities do not unite across, so that a connection between the amnion (proper) and the serous envelope—sero-amniotic connection—always remains along the line of union. The backward growth of the amniotic folds over the embryo does not stop at the posterior end, but continues to grow backward, although diminished in width, until finally there is produced a tube extending from the posterior end of the embryo, reaching a length as great as the embryo itself, and placing the cavity of the amnion into communication with the exterior.

In the Testudinata the allantois arises as a diverticulum from the posterior region of the midgut, and is from the first continuous with it. The later stages of the fœtal membranes are more complicated. The allantois is obstructed in its growth over the embryo by the sero-amniotic connection. Ultimately the allantois surrounds the yolk by means of its three lobes. "There is always, even in very much advanced eggs, a small mass of the white just at the point where the three lobes of the allantois meet at the lower pole." It seems that we have here, in a very primitive condition, the structure described by Duval as the placenta of birds. The yolk-sac passes into the interior of the body in hatching, where it lies for a long time, and may be found in young tortoises late in the spring of the year following.

Mitsukuri thinks that if the embryology of the groups of reptiles and birds are carefully gone over again many structures which are highly significant in the light of facts now obtained will be found to have hitherto escaped notice; for instance, the sero-amniotic connection and the posterior tube of the amnion. The amnion was probably developed originally by mechanical causes. In Testiudinata, when the head fold is produced, there are two reasons why it should sink into the yolk; "first, the yolk is very large and liquid, especially beneath the blastoderm; and, in the second place, the white disappears from over

[1] Edited by Thomas H. Morgan, Johns Hopkins University, Baltimore, Md.

the blastoderm, which then adheres firmly to the shell-membrane, hence there is no space for the head fold to grow, except towards below."

The Placenta of Rodents.—Duval has published a paper in the *Journal de l'Anatomie*[2] giving a clear and interesting account of the discovery of the "inversion" of the germ-layers of rodents, adding a theory of the method by which this curious process has been brought about, and illustrating the whole by an admirable series of diagrams.

With Bischoff (1842) the problem of the inversion originated, and its solution has gradually, since then, been worked out. We may pass through a series of forms showing the condition of inversion in its various stages,—in the hare, where it is simplest, through the field-mouse, rat, and mouse, to the guinea-pig, where it is most complicated. Unfortunately the early investigators began with the last form, and it is rather surprising they made as much as they did out of the process; indeed, Duval believes that, although often in error, Bischoff guessed the fundamental meaning of the phenomenon, and had a better knowledge of the process than some of the investigators that came after him.

Primarily the sinking of the blastodermic portion of the embryonic vesicle has been the cause of the inversion of the layers. This was closely connected with the formation of the ectodermic amnion which arches up over the embryo as the latter sinks into the vesicle. By the closure of the amnion above there is formed a cavity lined by ectoderm, which, owing to the sinking of the embryo, lies, as it were, in the center of the vesicle, but still *above* the embryo. This process takes place in its simplest form in the hare, but in the other rodents it takes place by an abbreviated condition; for the amniotic (ectodermic) space first appears as a *split* in the thickened ectoderm above the blastoderm. Subsequently the cavity of the amnion is divided into two parts, an upper and a lower, by a constriction formed in the middle. This division the author believes primarily to have taken place by the early development of the allantois in order that it might spread out under the upper (attached) pole of the embryo. In many forms the amnion divides into its two parts before the appearance of the allantois, and this is but a *precocious* process, caused in the first instance by the growth of the allantois.

On the Morphology of the Bilateral Ciliated Bands of the Echinoderm Larvæ.[1]—In a previous work (Die Entwickelung

[2] XXVI. Anne., No. 6, 1891.

[1] R. Semon, *Jenaische Zeitschrift*, XXV. (N. F., XVIII.), 1890.

der Synapta digitata (*Jen. Zeit.*, XXII.) the author refers to the preoral ciliated band as arising from the adoral band (surrounding the mouth), and not from the other ciliated band, from which it is entirely separated, thus opposing the older view of Gegenbaur, adopted by Korschelt and Heider in their Lehrbuch.

But the author's present work, begun in April, 1890, at Helgoland, shows that the adoral band arises without connection with the preoral band, and that the union of their edges is secondary. Thus ontogenetically is given striking proof of the correctness of Gegenbaur's supposition.

The stage where but a single ciliated band is present is called the Auricularia stage of the Bipinnaria.

In older larvæ the postoral and preoral portions of the longitudinal (circumoral) ciliated band unite at the preoral apical pole, and form a median unpaired stripe. Later, on a plane parallel to the ventral surface, this median unpaired stripe divides, and thus forms the preoral and postoral ciliated bands of the Bipinnaria.

The ciliated bands are formed by a loss of cilia and flattening of the cells over the rest of the body, thus leaving the bands as the only ciliated part. This process begins on the ventral side; the cilia disappear last at the apical pole.

The adoral ciliated band is formed in a similar way, and at its anterior part comes into close relation, secondarily, with the preoral band.

Thus is solved the only difficulty to Joh. Müller's plan to derive the body form and arrangement of the ciliated bands for all Dipleurula larvæ from a fundamental type, since it is shown that the Asterid larva passes through an Auricularia stage, and that the preoral ciliated band is separated from an ancestral single ciliated band. This stage with a single ciliated band is the typical form, ontogenetically reproduced in sufficiently young larvæ of all classes of Echinoderms.

The author notes as an interesting fact that in Joh. Müller's comparison the Ophiurid pluteus, by the increase of the posterior dorso-ventral bendings (auriculæ of the Auricularia and Bipinnaria), to long and characteristic projections, in this important point stands nearer the typical form than the Echinid pluteus to which in other respects it is more comparable.

He points out the close relation existing in all larvæ between the upper transverse border of the preoral band and the adoral ciliated band. He believes that the Dipleurula larva cannot be traced back to the *typical trochophore* with *preoral ciliated rings;* probably not to the

mesotrochal larva ; possibly it may be compared to a *telotrochal* larva, but it must be shown that the bands arise in a similar way in each. This is only a tentative suggestion.

. In Tornaria the arrangement of two longitudinal ciliated bands agrees throughout with the Asterid larva, as does also its internal development (cœlom sacks). Still, on account of the differences in the mature animals, it is difficult to show more than a very distant genetic relationship.

As a result of these observations, we believe that the Dipleurula larva, including Tornaria, are separated from the cilia-bearing larvæ of the higher and lower worms, as well as molluscs. An homologizing of the circumoral ciliated bands of Echinoderms with the cilia apparatus of the other larval types cannot be carried out. They probably are structures independently arising. The results on the nervous system of Asterid and Echinid larva were negative.

The author speaks of a bilateral fibre-system, united by a cross commissure, lying in the dorsal skin under the epithelium. It seems to take the place of a nervous system, and its structure recalls that of nervous tissue. The thicker fibres cannot be distinguished from the muscle fibres of the foregut, perhaps a little less transparent and certainly more branched. This may be regarded as a well-developed dermal musculature.—George W. Field.

PSYCHOLOGY.

Note on Imperfect Instinct in Animals.—On a number of occasions I have observed that the instinct of animals is sometimes shown to be imperfect, and reading Mr. George J. Romanes's book on "Mental Evolution in Animals," where mention is made of "imperfection of instinct" (page 167), his illustrations quoted recall to my mind some original observations which might add still further to the interest of this subject. Regarding insects, on July 4th, 1887, I noticed among the fireworks displayed upon an open stand, on the corner of a vacant lot in Chicago, a number of bunches of different-sized fire-crackers with their bright crimson covers conspicuously distributed among the other pieces of similar explosives. While I was standing close by a pretty, bright, reddish-brown butterfly, with silver spots on the under surface of the wings, which I supposed to be the larger species of Argynnis, came flying along near

the ground from the north. When nearly opposite, attracted by the bright color, it changed its course quickly and flew directly to the fire-crackers, trying one bunch and then another, as I have noticed the same species of butterfly do in a field at Hyde Park while feeding, going from one bright red flower to another. Then suddenly recovering itself, and as if coming to a point of realization of a mistake, the insect continued its headlong journey southward until lost to view. I find in my diary on June 24th, 1884, while I was standing on a street corner in Chicago waiting the arrival of a car, an Alypian moth (*Alypia octomaculata*) was attracted by the clothes which I wore at that time. The specimen was a beautiful male, and when I stood still it flew about my body in the air repeatedly, and persistently alighted on my clothes, although it was gently brushed away several times with my hand. The black and white on the moth coincided closely with the small checks of the same in my suit, the significance of which impressed me strongly at the time. Last summer (1890) I noticed several times that small white butterflies were attracted by bits of white pieces of paper which had been carelessly thrown upon the ground. An instance bearing upon this point is recorded in the AMERICAN NATURALIST (Vol. XX., page 976), in which many Ajax butterflies (*Papilio ajax*), which are wary and ordinarily captured with great difficulty, became attracted by dead specimens of the same species which I pinned upon the ends of twigs and stuck in the ground to serve as decoys. I was allowed to increase my collection with a number of additional specimens in this way by the use of a net, which could not have been otherwise taken.

In the matter of birds, it is an every-day experience of hunters to attract wild ducks and some other birds within gun-range by artificial decoys placed at a point where the birds can see them in passing over on the wing, and I have myself shot American golden plover frequently which were attracted by flat tin pieces which I had painted in imitation and cut in the shape of these birds, and stuck upon sticks which elevated them from the ground. In the latter case almost every individual in a flock of twenty to thirty have been shot in this way; and imitating their call-note would again and again call them back, although each time a number shot from the flock would fall to the ground, which were probably noticed by the birds that escaped the fire, for they sometimes dove down from above in the direction of the falling birds. It is interesting, although digressing a little from the subject in hand, to note that in localities where these birds frequented by thousands in their migrations some years ago, but few are seen now, and are fast follow-

ing in the path of the Carolina paroquet and wild pigeon, owing in a great measure to their inability to adapt their imperfect and limited instinct to the sudden encroachment of civilized man. I once attended a great fire which consumed a number of large warehouses and a great quantity of lumber. The fire occurred in the dead of the night, lighting up the surrounding vicinity brightly, and the heat was intense. While thus gazing at this spectacle I noticed dozens of tame doves and English sparrows, irresistibly drawn by the intense light, fly directly into the flames, and hundreds were consumed in less time than it takes to relate the observation. Similarly, on July 7th, 1890, I noticed in front of my office, where an electric light hung to light up the corner at night, numerous insects, some of the most grotesque forms of moths, among them such as I had never observed before, and a number of different species of beetles heedlessly plunging into the globe that surrounds the light, and were destroyed. Mr. Romanes says (page 174) that under the general heading of "Imperfection of Instinct" "we may include two very distinct classes of phenomena; for instincts may be imperfect because they have not yet been completely developed, or they may appear to be imperfect because not completely answering to some change in those circumstances of life with reference to which they have been fully developed." To which of the two phenomena the above notes will belong requires but little reflection on the part of the reader.—DR. JOSEPH L. HANCOCK.

An Instance of the Black Snake Attacking Man.—In the autumn of 1867 I was residing at Stamford, Conn., being at that time about seventeen years of age. Apart from my college studies, my entire time was given over to the subject of biology and the formation of collections of various animals. The country about Stamford was admirable ground for the collecting naturalist, and by the writer its advantages were not neglected. One day, during the time above mentioned, I was hunting in a piece of heavy hemlock timber about three miles from the town, and upon passing under a tall tree my attention was attracted by a swinging, rope-like object that hung suspended from its lower limb, immediately overhead. In an instant I recognized it as a large black snake (*B. constrictor*), and he was holding on by a coil or two of his tail, while his head was several feet above the reach of my outstretched arm and hand. His body was straightened out as straight as could be. It took but an instant for me to appreciate this extraordinary behavior on the part of a species of snake with which I was quite familiar. I was about to reach up and strike him with my gun-barrels, when in a twinkling he let go his hold, and in falling fell

all in a loose coil on my head and shoulder, but as quick as a flash twined himself about my neck, with the hinder third of his body twisted about my arm at the arm-pit. Rearing his head within a few inches of my face, and rapidly quivering his tongue at me, he was quite a picture to behold. It required but a moment or two, however, for me to demonstrate to this hardy and soot-tinted representative of the reptilian race that he had attacked a quarry entirely too big for his powers,—though I confess he warped down his constricting coils in a manner not to be despised as coming from so small a snake. Seizing him near the head, and leaning my gun against a tree, by three or four vigorous pulls I soon disengaged him, and his disappointed snakeship was taken home alive. He measured something less than six feet.—R. W. SHUFELDT, *Takoma, D. C., February 24th, 1891.*

ARCHEOLOGY AND ETHNOLOGY.[1]

International Congress of Anthropology and Prehistoric Archeology.—*Tenth Session, Paris, August 19 to 27, 1889.*—This congress grew out of the meeting at Spezzia, in Italy, in September, 1865, of four gentlemen of high reputation in connection with studies relative to prehistoric anthropology: Capellini, of Bologna; Gabriel de Mortillet, of Paris; Steenstrup, of Copenhagen; and Stoppani, of Italy. To further the organization, a meeting was agreed upon to be held at Neuchatel, in Switzerland, in the year following, 1866, and the organization was completed and the congress established at the meeting in Paris in 1867. The subsequent meetings were as follows: 1868, London and Norwich; 1869, Copenhagen; 1871, Bologna; 1872, Brussels; 1874, Stockholm; 1876, Budapest; 1878, Paris; 1880, Lisbon. Subsequent meetings were arranged for Rome and Athens, but were defeated by rumors of pestilence and war. The tenth session was organized to be held at Paris in the year 1889, thereby taking advantage of the French exposition and the many opportunities for study afforded, as well as the number of foreigners who would be in attendance.

The meetings were well attended, and brought together the most illustrious scientists of various nations. The influence of the congress was highly beneficial, and it deserved support. Not only did distant anthropologists and prehistoric archæologists become acquainted with

[1] Edited by Dr. Thomas Wilson, Smithsonian Institution, Washington, D. C.

each other, but they had a chance there to present new discoveries and announce new theories. The congresses act as an international clearing-house, and enable the scientists of the world to compare notes, and, if needs be, correct their errors. That the importance of these congresses has been recognized by the European anthropologists is demonstrated by the numbers in attendance, the average of which has been 588 members, while the session at Stockholm counted 1,642 adherents. The foreigners usually number about one-half the attendance. The average representation, stated by countries or nations, has been as follows: France, 126; Sweden, 115; Great Britain, 70; Belgium, 68; Italy, 45; Denmark, 41; Austria-Hungary, 35; Germany, 20; Portugal, 10; Russia, 8; Netherlands, Norway, and Finland, each 6; Switzerland and Roumania, each 5; United States of America, 4; Luxemburg, 2; Brazil, Greece, Turkey, Argentine Republic, each 1; all other nations taken together, 4.

A permanent council had general supervision of the affairs of the congress, but a committee of organization was charged with the duty of preparation.

The program for this session, as agreed upon by this committee and published in advance, was as follows: Monday, August 19th, 1889, 2 o'clock P.M. Address of the president. Report of the secretary-general. Election of the bureau and council. Additional by-laws.—Tuesday, August 20th, 1889, 9.30 A.M. Visit to the Museum of Natural History in the galleries of anthropology and paleontology. 2.00 P.M., regular meeting in the amphitheatre of the College of France.—Wednesday, August 21st, 1889, 9.00 A.M., meeting at College of France. 1.00 P.M., reception of the members of the congress by the municipality of Paris at the Hotel de Ville at 4.00 P.M.—Thursday, August 22d, 1889. Visit to the colonial display at the exposition. Rendezvous on the Esplanade des Invalides at the Tunisian Pavilion, 9.30 A.M. Visit to the exposition, section of anthropology, 2.00 P.M., and afterwards to the Museum of the Trocadero.—Friday, August 23d, 1889. Meeting at College of France, 9.00 A.M. and 2.00 P.M.—Saturday, August 24th, 1889. Excursion to Saint-Germain by steamer on the Seine, and visit to the museum. —Sunday, August 25th, 1889. Meeting at College of France, 9.00 A.M., and closing session at 2.00 P.M.—Monday, August 26th, 1889. Excursion by rail to Chelles, the great paleolithic station.

The questions proposed by the committee for discussion before the congress were as follows: 1. Denudation and filling of the valleys, filling of the caverns, and their relations to the antiquity of man. 2.

The periodicity of glacial phenomena. 3. Art and industry in the alluvial and in the caverns. Paleontologic and archeologic classifications, and their value as applied to the Quaternary period. 4. The chronological relation between the civilization of the ages of stone, of bronze, and of iron. 5. The relation between the civilizations of Hallstadt and similar Danubian prehistoric stations, and the civilization of Mycenæ, of Tiryns, of Hissarlik, and of the Caucasus. 6. A critical examination of the skulls and bones of the prehistoric man belonging to the Quaternary period discovered within the past fifteen years. The ethnic elements properly belonging to the ages of stone, bronze, and iron in Central and Western Europe. 7. Ethnographic survivals which may throw light upon the social state of primitive populations of Central and Western Europe. 8. How far do the analogies of archæology and ethnography authorize or sanction the hypothesis of relations between the peoples, and how far of prehistoric migration?

There were 450 members of the congress enrolled, though not all were present.

Twenty-seven countries were represented, of which nineteen were European, six of the two Americas, and one each from Asia and Oceanica. The congress at Lisbon was nearly as large as that at Paris. It had 417 enrolled members, of which 330 were foreigners to that country.

Monsieur de Quatrefages, the president, opened the congress by an address of welcome, and recalled to his hearers, in a few words, the history of the work of Forchammer, Worsaae, and Steenstrup in 1847, making a happy accord of natural history and archeology. These were founded upon modern sciences regarded up to that time as having a relation together, but which were nevertheless united by an alliance that has become more and more fruitful. From this the past of the human race plunged in an immense unknown, far beyond the reach of history or even the most obscure legends, and embracing only the geologic times with which their investigations had to deal. These investigations were published, and soon it was recognized that one branch more had been developed on the tree of human knowledge.

M. de Quatrefages followed the International Congress of Anthropology and Prehistoric Archeology from its foundation and commencement in 1865 or 1867 through each one of its sessions. The session then opened at Paris had among the others an extreme importance. The first question on the program, "The Geology of Prehistoric Times," was a declaration of our profession of faith. In adopting the

sixth question, "Our Notions Anthropologic," the congress testified that one of its subjects of investigation is attached to antiquity, which becomes an object essential to its studies, and one to be followed in all paths of the science. Comparative ethnography throws light on our primitive ancestors, while geography comes in as an important and efficient aid.

The congress in dealing with the question of fossil man would not sustain on the one part dogmatism, nor on the other philosophy. This will explain its triumphs in the different countries in which it has met.

The secretary-general, Dr. Hamy, then told of the steps which had been taken in order to protect this meeting of the congress against the difficulties encountered at Lisbon, and augmented by the death of the late secretary-general. He described step by step the action taken by the officers and original founders, and it was at last decided that M. de Quatrefages would be the president. He then named the committee of organization, and announced the bureau and council as follows:

President, M. A. de Quatrefages; vice presidents, MM. Belucci (G.), Beneden (J.-L. van), Bertrand (Alex.), Bogdanoff, Delgado (N.), Evans (J.), Hilderbrand (H.), Gaudry (Alb.), Mason (Otis T.), Muller (Soph.), Schliemann (H.), Vilanova; secretary-general, Hamy (E. T.); secretaries, MM. Boule (M.), Cartailhac (Em.), Deniker (J.), Fraipont (J.), Vasconcellos-Abreu Verneau (Dr.); council, MM. Benedikt, Cotteau, Gosse (Dr.), Hovelacque, Lumholtz, Netto (Ladislas), Odobesco, Riedel (J. F.), Schmidt (Valdemar), Szabo (de).

The first question proposed by the committee of organization was: "The Cutting and Filling of the Valleys, the Filling of the Caverns, and These in Their Bearing upon the Antiquity of Man."

M. Gaudry was the reporter. "It is not certain," said he, "that in our country man has lived a long enough time that the contemporaneous animals of his antiquity should produce the notable transformation which would serve as datum points. The savants having the greatest experience with the objects made and used by early man are not in entire accord." A good thing from which to determine successive stage of man during the prehistoric times is stratigraphic geology. There are three points in the Plistocene geologic period which are particularly important to establish the age of the strata which contains the traces of man:

1. The glacial and interglacial formations; example, Rixdorf. The observations in divers places in Germany and in England demonstrates that there have been several interglacial formations.

2. The great Glacial age. In England and in Norfolk the boulder clay, that is evidence of the grand Glacial epoch, is above the forest beds. In consequence, the depots at Chelles and Montreuil, which contain the animals of a warm temperate climate, do not correspond with the earlier epoch of Plistocene that followed the age of the forest bed. M. Gaudry supposed this to be a depot of the interglacial age of Rixdorf; and that it is, in any event, a Plistocene deposit, not relatively of antiquity.

3. The cutting of the valleys. The theory of Prestwich was that the Plistocene deposits, the most elevated, are the most ancient. In general this ought to be true in France. The locality of Vaucresson, 150 metres above the sea, of Montreuil-sous-Bois, 100 metres, both of a Quaternary period, very ancient, contemporaneous with the grand glaciers of the north of Europe, and characterized by abundant remains of reindeer, mammoth, and the wooly rhinoceros associated with chipped flints, are illustrations. The Chellèen of Bas Montreuil, and of Chelles with deer, *Rhinoceros merkii*, *Elephas antiquus*, are grand interglacial depots, during which the climate became warmer, and the melting of the gigantic masses of glacial ice produced immense erosion. Finally, M. Gaudry believed that the alluvium of the lower level, where they find the mammoth, reindeer, and the *Rhinoceros tichorhinus*, represents a return of the cold.

It was contested that if the valley of the Seine was cut in the beginning of the Quaternary epoch, the Chellèen ought to be more ancient than the depot of Haut-Montreuil. It was necessary that the stratigraphic geologist should mark in a precise and indisputable manner the age of the cutting and the depots of our valleys of the Seine.

Professor Geikie, the Scotch geologist, sent a paper on this subject, which was read. The relative positions of the fluvial strata of a valley do not necessarily indicate their antiquity, and the elevated strata are not necessarily the most ancient. In certain cases there have been grave exaggerations of fluvial cutting accomplished during the Pleistocene times. Our grand valleys in Scotland were cut before the Glacial period, and at an epoch which M. Geikie does not dare to fix with precision. These valleys continued to be cut during the Pleistocene period. Those which are in the region covered by the glaciers have naturally escaped this action. As for the levels of the gravels, the inferior or lower ones simply indicate a normal state of the water-course, as the superior or higher ones testify to the torrential action of the river. We do not possess any serious or certain knowledge that will permit us to calculate the degree of cutting operation in

the valleys of the northwest of Europe during the time these regions were occupied by paleolithic man. We can only affirm that the cutting is the result of alluvial action very much prolonged.

Mr. Geikie sent a second paper on the periodicity of glacial phenomena. He did not enter into the question as an argument. He simply referred to his two works in which the question had been argued at length: "The Great Ice Age," and "Prehistoric Europe," and said he was content with conclusions he had therein announced in favor of that periodicity.

M. Adrien de Mortillet was of the opinion that the theory of the three levels, the higher, the middle, and the lower of Prestwich, came from Belgrand. This theory was not affected by the fact that there had been found at the bottom of the grave the bones of the *Rhinoceros merkii* and fossil animals which belonged to the Chellèen epoch of the Paleolithic age. Monsieur van den Broeck refused his adhesion to the last conclusion, and declared that if true it revoked the laws of nature. He said if these lower deposits contained the ancient fossils they must have been redeposited, and these, therefore, were valueless as to the question of their antiquity. He insisted upon the importance, for the purposes of study of primitive archeology, and for the determination of the age of the objects of human industry found in the alluvial deposits, of the superficial strata of the soil and the infiltration of the water to the lower strata, by which the latter were changed in their character and appearance.

Dr. Gosse presented certain Chellèen implements, the first of this type found in Switzerland, and with them charts of the Lake of Geneva, which showed successive stages by which the alluvium was deposited, and which corresponded in the level with others in which had been gathered the mammoth, reindeer, and below all, Roman antiquities.

M. Cartailhac doubted whether this implement was Chellèen.

Mr. John Evans visited, now thirty years ago, Saint Acheul, in company with Prestwich, and he adopted with all his heart that which had been said by that great geologist. The paleontologic evidences are uncertain and sometimes founded in error. At Norfolk, for example, there is in one stratum *Elephas antiquus*, in the same the *primigenius*, and it is impossible to establish in the stratum a proper division.

M. Gabreil de Mortillet defended the geologists against the reproach of neglect in investigations into the prehistoric. The cutting of the valleys is a question difficult to solve. The wisest man with the most extensive knowledge seems unable to harmonize all the facts of geology.

It can only be done by extensive acquaintance with facts. The Tertiary plateau of Paris at the beginning of the Miocene was horizontal and intact and 170 metres in elevation. It was profoundly affected by the Seine during the Tertiary, which made a colossal cutting compared with that of the Plistocene, which in Paris is only 40 metres in elevation. The movements of the soil explain perfectly the conclusions as to the filling of the valleys at the periods of depression, and of cutting during the periods of elevation.

Monsieur Mourlon, of Brussels, said that diversity of views and differences of opinion proved that the solution of this problem is yet far distant. He recommended that each person should take up his own proper study in his own country, and pursue it without any preconceived ideas or opinions. He explained the situation at Mons and Ixelles as identical with that of Igtham presented by Mr. Prestwich, and said that the deposits were doubtless Pliocene, yet they found chipped flints of the Moustier type.

M. Marellin Boule said that he had studied the fossil bones of Ixelles at the museum, and that all the species belong to the fauna of the *primigenius.* The deposit at Ixelles is probably not older than the commencement of the Plistocene as we know it in France. In any event, it does not belong to the Pliocene.

Gosselet, of Lille, objected that Mr. Prestwich was too uncertain. He always said "It is perhaps" pre-Glacial, etc. Yet M. Gosselet was opposed to M. Mourlon in his opinion that the deposits at Mons were anterior to the Plistocene.

M. Max Lohest said that none of the numberless depots yet discovered in the caverns were characteristic of any determined geologic epoch. Fauna of the mammoth and *Rhinoceros tichorhinus* are found as well in the red plastic clay, the rolled pebble, and the stratified mud as in the clay full of sharp stones which came from the roof of the cavern. He attacked the theory of M. Dupont, and declared that the height of elevation of a cavern above the level of the river was not evidence of its antiquity, and that the formation of the Belgium valleys had begun anterior to the Cretaceous epoch. The clay of the plateaux in the east of Belgium that came from the cutting of the valleys was deposited probably anterior to the age of the mammoth. On the arrival of man the face of the country presented much the same appearance as now.

Monsieur van den Broeck, of Belgium, responded to his colleagues, MM. Mourlon and Max Lohest. In his opinion the Belgium valleys were not cut until after the Pliocene, because we found the sedi-

ment of that epoch crowning the hills and plateaux in the neighborhood of the valley. In the valley of the Meuse, M. van den Broeck cited evidence to prove that the lower levels were much more recent than the high levels. Localities cited by M. Mourlon were not pre-Plistocene, because both were situated on the flank of the valley, and not on the Plistocene of the plateaux. The fauna of a cavern could only be the same as that of the valley.

Mr. John Evans was in accord with those who said that the great valleys had been cut before the Plistocene, but we should not forget that there may be valleys of all epochs. He approved the opinions and conclusions of Prestwich, but only in regard to that which concerns the Plistocene, and said that neither himself nor other geologists of England could follow Mr. Prestwich in his theory of the worked flint being pre-Glacial. In his opinion the deposit of the worked flint at Igtham was a superposition well established.

Mr. Thomas Wilson said a few words upon the progress made by American geologists on the subject of the Plistocene period and the antiquity of man. He spoke of the interest in that subject in his country. He showed to the congress some of the quartzite and argillite implements which belong to the paleolithic period, and had been discovered on the surface in his country, as had been those Chellèen implements found by Mr. Prestwich at the locality of Igtham in Kent. On the subject of the cutting of the valleys and their subsequent filling, he remarked that the rivers of France and England especially were of such short length that it was possible the operation may not have been carried out to its conclusion by the courses of nature, and he invited the geologists of Europe who were interested in studying this question not to neglect the opportunity of visiting the United States upon the occasion of the next geologic congress, to be held in 1891, that they might investigate our rivers; those flowing from the mountains to the Atlantic seaboard, some of them passing through the glacial moraine, like the Connecticut, Hudson, and Delaware, others others coming from mountains unaffected by the glaciers, as the Susquehanna, Potomac, and James; or go to the west, where were to be found rivers from 1,000 to 4,000 miles in length, as the Ohio, Cumberland, Tennessee, Mississippi, and Missouri, on the banks of which are to be found cut the same kind of caverns as those of Belgium, as were also the terraces of the high, low, and middle levels of Prestwich, Belgrand, and Mortillet; they were thus to be found, not in isolated positions, but stretched out for hundreds of miles. The earth cut from one place would be carried to another further down, and so deposited and redeposited many, many times before reaching the ocean.

Monsieur Judge Piette described at length the position, condition, and geologic formation of the great cavern of Mas d'Azil, Ariege; how it was found in a tunnel made under or through the mountain by the passage of the river l'Arize, and how it had been inhabited by prehistoric man during all epochs. He had visited this cavern, which is a stupendous and wonderful work of nature, his interest being correspondingly excited because in it were to be found in great quantities and great thickness, in different parts of the caverns the evidence of the occupation by prehistoric man in all his epochs; the paleolithic, the earliest cavern epoch, down to and including the neolithic and even bronze age.

M. Chambrun de Rosemont and Madame Clemence Royer gave their opinions. Monsieur Gosselet confined himself to the question which was being discussed, and gave it as his opinion that there were to be found the following phenomena in the cutting of the valleys: 1. A first cutting anterior to the deposit of the lower or earliest Plistocene. 2. A second cutting posterior to the deposit of the yellow clay, but anterior to the upper diluvium. These repose indifferently on the strata of the lower Plistocenc, and which may have been more or less eroded. Sometimes the gravels of the two epochs are superposed. 3. A third cutting posterior to the Plistocene period. Sometimes this finds the Plistocene in the valleys; but it is not infrequent to find the Tertiary and even the secondary deposit exposit exposed by the cutting. 4. After this last cutting the water of the rain and the rivulets produced a heterogeneous clayey deposit that covered the slopes and descended even to the bottom of the valleys. In this one can find the *débris* of the age of polished stone, of Roman objects, and others similar. The relations of the divisions in the fauna and the human industry of the Plistocene epoch have not been determined.

M. de Szabo described the Plistocene formations in Hungary.—THOMAS WILSON. (*To be continued.*)

The Munich Association for the study of anthropology, ethnology, and prehistorics is publishing its transactions in an organ called *Beiträge zur Anthropologie und Urgeschichte Bayerns*, which has now reached its ninth volume. Professors J. Ranke and N. Rüdinger are the editors, and a series of most important papers have filled its pages since publication began.

The fourth number of Volume VIII., which is now before us, contains an elaborate inquiry into the racial groups now forming the population of the Bavarian province Oberfranken, northeastern part, com-

posed by Ludwig Zapf. The article is accompanied by a map showing that the district where the rustics have preserved the customary *wendic dress* is in part identical with the district embracing the dark-hued color of the eyes, though this extends somewhat further to the south. The author bases his ethnographic division upon the linguistic facts observed there, *four* dialects being spoken in that section.

In the same number Dr. Höfler discusses Bavarian dialectic terms for diseases and for the parts of the human body, and Hugo Arnold gives an illustrated report on recent excavations made at Pfünz and Faimingen, which resulted in the discovery of Roman temples erected for the worship of Jupiter Dolichenus and of idols representing this deity.

The numbers 1 and 2 of Vol. IX. of the *Beiträge* are united in one fascicle, and contain in eighty-five pages much that is of interest, though the contents refer more to local than to general topics of archeology and ethnology. Ten plates illustrate the articles, of which may be mentioned as the most likely to attract attention : Oldest Inhabitants of Southern Bavaria, by Sopp ; Prehistoric Sketches from the Tract between Inn and Salzach Rivers, by Weber ; The Home of the Bajuwarian Landholder, by Tresel ; On the Difference of Age in Population Statistics, by G. von Mayr ; Hill Tomb near Dechsendorf, by A. Erhard ; New Prehistoric Discoveries in Bavaria, by Weber. The appendix of thirty-four pages gives the minutes of the transactions of the Anthropologic Society of the Bavarian capital during the earlier months of 1889.

The Map of Prehistoric Bavaria, in fifteen sheets, the laborious work of Prof. F. Ohlenschlager, is now completed, for the last three sheets have just been distributed with the third number of Vol. IX. to the subscribers. The official removal of the author from Munich, the capital, to other functions in a Rhenish province of the same kingdom has retarded the completion of the map for more than two years, and the publication of the whole map was effected in the period from 1879 to 1890. The important discoveries made during the latest years made it possible for archeologists to establish a relative chronology for the objects of the Hallstatt and La Tène epoch, and this circumstance has largely enhanced the value of the map, the study of which is facilitated by copious indexing. The colored signs pointing to the places of discovery are twenty-three in number. The topographic data are all entered upon the military survey map of Southwestern Germany.

MICROSCOPY.[1]

The Pycnogonids.[2]—Three genera of Pycnogonids, each with a single species, are to be found at Wood's Holl,—viz., *Pallene empusa, Phoxichilidium maxillare* Smith (*Anoplodactylus lentus* Wilson), and *Tanystylum orbiculare.* During July, August, and September these are found with eggs. Pallene inhabits the hydroids (Tubularia, Pennaria) on the piles of the wharves, and is also common on the red sea-weeds below low-tide mark. The hydroids or sea-weeds as soon as collected were brought into the laboratory and worked over piece by piece. Each bunch was in turn swished rapidly backward and forward in a dish containing a small amount of water, so that the Pycnogonids were shaken loose and could be easily picked out. The other genera were more easily found, and on separating the masses of hydroids, etc., could be readily seen clinging to the stems. The males of Pallene carry on each pair of ovigerous legs a small bunch of eggs. Each bunch contains from one or two to fifteen or twenty eggs. The eggs of Phoxichilidium and Tanystylum are individually much smaller than the last, but are very numerous, so that the bunches are much larger, especially so in the former. Phoxichilidium carries several bunches strung along on the ovigerous legs; the bunches are white, and very conspicuous against the purple color of the adult. Tanystylum has smaller bunches of eggs, with the individual eggs larger than the former, and the masses are carried so that they form a circle of clusters held against the ventral side.

The adults with eggs were put into alcoholic picro-sulphuric acid for several hours, and then gradually carried through different grades of alcohol. Other methods of hardening gave far less satisfactory results, —*i.e.*, boiling water or Flemming's solution.

To prepare the eggs and embryos for study they were passed through absolute alcohol (one hour), turpentine (two to four hours), soft paraffine (one hour), hard paraffine (one to two hours). They were cut in paraffine, and fixed to the slide with albumen fixative; then back again through turpentine, alsolute alcohol, ninety-five per cent., eighty per cent., seventy per cent. alcohol to Kleinenberg's hæmatoxylin, where they were left for a very long time (twelve to forty-eight hours); then washed fifteen minutes in acid alcohol, and up again

[1] Edited by C. O. Whitman, Clark University, Worcester, Mass.

[2] T. H. Morgan. Studies Biol. Lab., V., 1, 1891, pp. 2, 3.

through the alcohol to turpentine and into balsam. In Pallene each egg was in many cases pricked with a very sharp needle before going into absolute alcohol. It is necessary to do this under a dissecting microscope. By these methods very excellent results were often obtained, aud after many failures of other methods was found to be the only satisfactory one. In Pallene the larger size of the egg makes a study of the earlier stages much easier, but the other genera have a much simpler development.

Method of Rendering Opaque Nemertean Eggs Transparent.—The eggs of Nemerteans which have a direct development are opaque, and cannot be rendered transparent by ordinary reagents. This difficulty was overcome by Barrois[3] by the use of carmine and glycerine. The mixture must be allowed to act gradually, otherwise it causes deformations. Three mixtures, containing glycerine in increasing proportions were used, the first consisting of one part glycerine to four parts water; the second, equal parts of glycerine and water; the third, three parts of glycerine to one of water. Enough carmine was added to give the mixture a wine color. Each mixture was allowed to act some minutes, and then the eggs were examined under slight compression.

Method of Narcotizing Hydroids, Actiniæ, etc.—In order to kill Hydroids, Actiniæ, and similar forms in an expanded condition, a little expedient may be recommended which the writer has tried in many places and on many forms, and has uniformly found of value. The animals to be killed are left in a small quantity of the salt water in which they were brought in, until this becomes rather warm and stale, or until, in fact, they are weakened by the narcotizing effect of impure water. This manifests itself in one or two ways; some forms draw themselves completely together, while others hang half expanded and limp in the water. They are then transferred in colonies or in large groups into *fresh salt water* which is at the same time cool. The effect of a mass of cool, pure water is such as to cause the animals to expand fully and promptly. Immediately as the expansion is seen to reach its maximum, in the course usually of a few seconds, they are transferred by a quick motion to some rapid killing reagent. After the long narcosis in poor water, the polyps appear to lack energy enough to contract forcibly, as is usually the case. As killing reagents, alcoholic corrosive sublimate and picro-nitric acid have given the most uniformly good results. In this way the most susceptible

[3] Recherches sur l'embryologie des Némertes. Lille., 1877, p. 101.

Actiniæ may be easily preserved expanded and intact, and Hydroids of all genera yield good specimens. The transfer to fresh sea-water is the only point requiring care. No time limit can be given, as the factors are too variable; but a little practice is sure to show the character and advantages of this method.—H. B. WARD, *Cambridge, Mass.*

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Boston Society of Natural History.—December 3d, 1890.—Dr. J. Walter Fewkes spoke of "The Summer Ceremonials of the Zuñi Indians: a Study of Aboriginal Religion."

December 17th.—Prof. A. E. Dolbear read a paper on "The Physics of Crystalline and Cellular Structure." A communication on "Kame Ridges and Hillocks of Hingham," by Mr. T. T. Bouvé, was also presented.

January 7th, 1891.—Business: Election of members. Final action on the proposed new by-laws was taken by the society. Mr. J. G. Owens read a paper on "A Few Games of the Zuñi Indians."

January 21st.—Prof. A. E. Dolbear read a paper on "The Physics of Crystalline and Cellular Structure."

February 4th.—Mr. G. H. Barton described "The Hawaiian Islands: Their Natural History and Inhabitants." The paper was illustrated with a stereopticon. Mr. J. H. Emerton exhibited a new model of Oahu, which he has lately made for the museum of the society.

February 18th.—Mr. Warren Upham spoke of "Walden, Cochituate, and other Lakes Enclosed by Modified Drift." Prof. W. H. Niles presented a paper on "Notes upon Asphaltum Deposits in California."

March 4th.—Prof. W. M. Davis presented a paper entitled "Illustration of the Faulted Monoclinal Structure and Topographic Development of the Triassic Formation of Connecticut by a Working Model." Prof. N. S. Shaler spoke on the "Antiquity of the Glacial Period." Prof. Shaler called the attention of the society to the Dorkin photographs.

March 18th.—Dr. G. Baur read a paper on "The Importance of a Scientific Investigation of the Galapagos Islands." Prof. W. O. Crosby made a communication "On the Colors of Soils."

April 1st.—Dr. H. C. Ernst spoke on the latest developments in the "Germ Theory of Disease," illustrated by stereopticon and exhibition of tube-cultures.—J. WALTER FEWKES, *Secretary.*

Biological Society of Washington.—December 13th, 1890.—The following communications were read: The Occurrence of an Asiatic Cuckoo on the Pribylov Islands; Mr. William Palmer. New Notes on the Genus Phylloxera; Prof. C. V. Riley. The Teeth of the Muskrat; Mr. F. W. True. The Wing of Metopidius; Mr. F. A. Lucas.

December 27th.—The following communications were read: A Preliminary Study of Ticks in the United States; Dr. Cooper Curtice. Exhibition of a New Rabbit from the Snake Plains of Idaho; Dr. C. Hart Merriam. On the Topography of Florida, with Reference to Its Bearing on Fossil Faunas; Mr. W. H. Dall.

February 7th, 1891.—The following communications were read: Discovery of Vertebrate Life in Lower Silurian (Ordovician) Strata; Mr. C. D. Walcott. A Review of the Discovery of the Cretaceous Mammalia; Prof. Henry F. Osborn.

March 7th.—Communications: Exhibition of Young Hoatzins; A Specimen of *Bison latifrons* from Florida; Mr. F. A. Lucas. The Fishes of Great South Bay, Long Island; Dr. T. H. Bean. A New Aster from Southern California; Mr. J. N. Rose. Color and Odor of Flowers in Attracting Insects; Mr. Geo. B. Sudworth. Embryo of a Chick with Two Protovertebræ; Mr. J. M. Stedman.

March 21st.—Dr. W. H. Dall spoke upon the "Age of the Peace Creek Bone-Beds of Florida." Reference was made to the discovery of bones of various sorts by the Coast Survey and other exploring parties, while the recent explorations for phosphates have brought many more to light. In some counties the sticky clay containing the bones occurs in cavities of Eocene and Miocene rocks. The occurrence of bones in these localities indicates that the animals had become mired in attempting to cross swampy ground; and their appearance indicates that they had been gnawed by carnivorous animals. Evidences of fire are also present, but it was considered that lightning, and not man, was the probable cause. Some authors called the strata containing the bones Miocene, some Pliocene, and some Quaternary.

The bones found are those of the Elephas, Rhinoceros, Mastodon, Llama, Deer, Hippotherium, Equus, Tiger, Tapir, Buffalo, Megatherium, Megalonyx, Glyptodon, Porpoise, and Alligator, besides many fish fragments. Professor Cope had made a comparison between the Florida remains and those of the west, particularly the Loup Fork beds, of Miocene age. Some forms, however, were similar to those of the Equus beds, of Pliocene age. The Florida remains were, Cope thought, of an epoch between the Loup Fork and the Equus beds.

Dr. Dall stated that he had lately visited the Peace Creek locality for the special purpose of settling the age of the deposit. He explained the method of dredging for the phosphate in the river, stating that 200 tons per day were obtained. It is mostly in the form of pebbles about the size of marbles. Above Arcadia he found a section along the river bank which showed a bed with the bones *in situ*. The layer was about 1½ feet thick, overlying strata of Pliocene age (as shown by marine shells); and the bone bed was in turn overlain by a deposit of phosphatic material. The bones, therefore, could not be older than the Pliocene, and as the marl above them was covered in turn by a stratum which also contains Pliocene marine fossils, the conclusion was inevitable that the bone beds of that locality, at least, were of Middle Pliocene age.

Dr. R. W. Shufeldt read a paper "On a Collection of Fossil Birds from the Equus Beds of Oregon," from the collection of Prof. E. D. Cope. He first described the features of Silver Lake, a beautiful sheet of water frequented by great numbers of water birds. "Fossil Lake" was the bed of a dried-up lake, not many miles distant; and in the fine silt of this locality many bird remains had been discovered by Prof. Condon and Prof. Cope. He thought there were at least twenty undescribed extinct species. Indian relics, implements of obsidian, were found in the same bed as the bird remains, though it could not be asserted positively that the two were contemporaneous.

Mr. F. A. Lucas spoke of the anatomy of Hesperornis, the gigantic, extinct, toothed bird. He compared it with various living birds, and concluded the evidence indicated a foot patterned after that of the grebe, but more highly specialized. With Marsh he did not think it was a land bird, or that it used its wings in swimming, but that it was a highly specialized aquatic.

Mr. F. H. Knowlton discussed the function of cypress knees. He referred to the idea advanced in 1848 that these knees, which vary in height from one inch to two, four, and even ten feet, performed the function of aëration. This idea had been later on fully elaborated by Prof. N. S. Shaler. Another theory, advanced by Dr. Lamborn, is that the knees buttress the trees, and so prevent violent winds from uprooting them. The latter idea seemed very plausible, as it was an undoubted fact that no one had ever seen an uprooted cypress tree. Prof. Shaler had contended that when the knees were submerged the tree invariably died, but this was stated not to be the case.

Prof. L. F. Ward, in discussing the paper, expressed his disbelief in the theory that the knees were for the purpose of increasing the areat-

ing surface. He described the appearance they presented, and stated his belief that they certainly furnished support to the tree in many cases. He questioned the fact of this being their original purpose, but thought it might be the after result. He mentioned a tree planted by Bartram, near Philadelphia, which grew in dry ground, and had knees 100 yards from the trunk. This tree was probably one hundred years old, and had never grown in or near the water. He advanced the idea that the knees were only aborted shoots, thrown up from the roots like the suckers of the silver poplar and ailanthus. Water he did not consider necessary for the growth of the knees. He had not seen any tree actually arising from a knee and so connected with the parent, but he believed investigation would show that the knees were of the nature of aborted sprouts.—JOSEPH F. JAMES.

Proceedings of the Natural Science Association of Staten Island.—November 8th, 1890.—This being the annual meeting, reports of officers for the past year were read and accepted. The treasurer reported an income of $168.08 and expenses amounting to $116.83, leaving a balance of $51.25 in the treasury.

The election of officers for the ensuing year resulted as follows: President, Dr. N. L. Britton; treasurer, Eberhard Faber; recording secretary, Chas. F. Simons; corresponding secretary, Arthur Hollick; curator, Jos. C. Thompson.

Dr. Britton alluded to his recent proposition (see Bulletin Torrey Botanical Club, Vol. XVII., p. 121) to recognize plants which, with greater or less frequency, bear flowers of a color other than the normal hue under the rank of "forms," the difference not being sufficient to class them as varieties. Thus the common salt-marsh pink (*Sabbatia stellaris*), whose flowers are normally red, occasionally produces them of a pure white color, and this albino condition was therefore described under the name *Sabbatia stellaris* forma *albiflora*. This form has recently been collected in considerable quantity in the meadows back of South Beach, where it grows with the ordinary red-flowered form, and in certain patches is equally abundant. Another salt-marsh species of this genus (*S. dodecandra*), observed by Mr. Eadie at Old Place, and by Mr. Hollick at Kreischerville, has not yet been reported in the albino form from our region, but has been noticed in New Jersey.

The painted cup (*Castilleia coccinea*), which formerly grew in large quantities in the Cove Lake swamp, but is now to a considerable extent obliterated there, usually produced some plants with orange or yellow bracts, their ordinary color being scarlet. The same occurrence has been reported in other districts.

Some years ago Mr. Hollick collected a plant of the New England aster (*Aster novæ-angliæ*) at West New Brighton, which, instead of having the ordinary purple rays, had them rose-colored. This had been described by Dr. Gray as var. *roseus*, but it manifestly falls into the rank here alluded to as "forms," and I should propose to call it *A. novæ-angliæ* forma *roseus* Gray.

Mr. Hollick exhibited specimens of lignite and pyrite from the recently opened fire-clay beds at Green Ridge. This clay has been mined in this locality to a depth of about thirty feet. It is covered by from six to ten feet of drift, and is undoubtedly of Cretaceous age, the same as the Kreischerville clays, the two no doubt being continuous. About three-fourths of a mile to the eastward, at Fresh Kills, drift clay is being mined to as great a depth, but there is as yet no indication of the Cretaceous clay being near at hand. Both these localities were visited on election day on the occasion of the annual field day with the Torrey Botanical Club and Brooklyn Institute, at which time the specimens were collected. Mr. Hollick also reported that on the same day a new locality was discovered for wintergreen (*Gaultheria procumbens*), near Giffords, where there was a large patch full of berries.

March 14th, 1891.—A paper was read by Mr. Charles W. Leng, "Notes on Some Species of Donacia," as follows:

It has been my task during the past few months to make a revision of the genus Donacia, in the prosecution of which I have, with the assistance of my fellow coleopterists, Messrs. Davis and Thompson, collected considerable numbers of those species inhabiting Staten Island. Their specific identity has thus become known to me, and certain facts respecting their habits which have not been elsewhere definitely recorded seem to be proper matter for these proceedings.

There are about twenty species inhabiting the United States and Canada, of which five only are known to occur here. It is possible, however, that additional species may be found by sweeping damp meadows with a net in June and July, a method not adopted by us last year.

The genus is quite homogeneous, and the species are indeed so much alike that most collections are in some confusion. The body beneath is more or less flattened and densely clothed with decumbent hairs, lustrous and resembling silk or satin, according to the fancy of the describer. These hairs serve as a protection against the moisture to which their pond-frequenting habits expose the insects. The color above varies from coppery bronze to testaceous, more or less mottled

with metallic green. The length is about half an inch. The antennæ and legs are comparatively long, and the variation in the length of the joints of the one and in the spinous processes which adorn the other afford the most convenient characters, combined with the form of the elytral apices, for the separation of the species. They may be known as follows:

Prothorax not tuberculate, scarcely punctulate;
  Third joint of antennæ little, if any, larger than second;
    Elytra squarely truncate, *lucida.*
  Third joint of antennæ at least twice as long as second;
    Elytra squarely truncate, *palmata.*
    Elytra more convex, subtruncate, *piscatrix.*
Prothorax not tuberculate, coarsely, densely punctate;
  Third joint of antennæ little longer than second;
    Elytra squarely truncate, *subtilis.*
Prothorax evidently tuberculate, scarcely punctate;
  Third joint of antennæ little longer than second;
    Elytra more convex, subtruncate, *tuberculata.*

In addition to the above, the sexual characters assist in separating the species. All the males have the last dorsal segment, called the pygidium or podex, short and truncate; the females have the same part longer and rounded at apex. The male of *lucida* has the posterior femora spinose, often armed with two or three spines; the female has but one spine. The sexes of *palmata* and *piscatrix* differ similarly in the femora; the male *palmata* is further distinguished by a dilation of the first joint of the anterior tarsi, and the male of *piscatrix* by an excavation of the first ventral segment. The sexes of *subtilis* differ but little; both have the posterior femora unidentate. The male of *tuberculata* has but one spine, but the female is without any.

From the results of last season's collecting I am satisfied that the above-described species affect different aquatic or subaquatic plants; the first three appertaining to the water-lilies, *subtilis* to the rushes growing at the pond margin, and *tuberculata* to the Sagittaria. The evidence I have is as follows: Our collections were made principally at Britton's ice pond, at the small pond on top of Todt Hill, and at Butler's or Galloway's pond near Garretson station. In all of them the yellow water-lily grows abundantly, mingled with the white water-lily, but only at Butler's pond do gradually shelving banks afford the

marshy stretch necessary to a free growth of the rushes. At all of these ponds the first three species of Donacia were abundant, but only at Butler's did we find *subtilis*. At that pond were many specimens, some resting on the lily pads, but the greater number on the stalks of the rushes. (Identified by Mr. Arthur Hollick as *Juncus effusus* L.) Mr. C. M. Weed, in the Bull. Ohio Ex. Sta., Oct., 1889, describes the abundance of *subtilis* in a similar situation near Columbus. My friend, Mr. E. M. Hulbert, tells me it is abundant near New Britain on sweet flag, and "no water-lilies within a mile, and no other species found."

In regard to *lucida*, *palmata*, and *piscatrix*, all three have been taken often on the leaves of the lilies and within the flowers, and there is a further confirmation of their lily-frequenting habits derived from an observation of the roots of that plant. In the operation of cleaning the ponds for winter, the icemen drag out the ranker growth of lilies and throw them, roots and all, on the banks. I have found in November oval cases of a thin but tough material attached to these roots and containing Donaciæ in the imago and larval stages. These cocoons are waterproof, and enable the beetle to pass the winter under two or three feet of water, or perhaps, when near the bank, imbedded in ice.

The larvæ of our American Donaciæ have not been described, and though I have dried specimens I cannot venture to make a complete description. They appear to be whitish grubs, about half an inch in length, with the head darker, but not otherwise conspicuous. The body appears to taper slightly beyond the head.

I have searched about the plants inhabited by *subtilis* for similar cocoons, but hitherto unsuccessfully. Many of the stems are now eaten, possibly by its larva, and among the roots are empty cases, but these might have been washed up from the pond.

The last species, *tuberculata*, is known to us on Staten Island by a single specimen taken on Sagittaria. It was however, taken in numbers by Mr. Davis and myself in the cranberry bog at Jamesburg, N. J., on the same plant. Water-lilies occurred a few hundred yards away, and on their leaves were a few specimens of *lucida*, but on the Sagittaria only *tuberculata*.

The life-history indicated by these observations is certainly a curious chapter in coleopterology. The parent beetles hover about the food plant proper for their offspring. They lay thereon their eggs, and the larvæ hatching, eat and grow fat until the approach of winter warns them to prepare the waterproof case for their coming transformation, within which the perfect insect develops and lies dormant until the following summer, when he emerges to repeat the cycle. It is, of

course, no more than all the butterflies do, but possesses a special interest from the accompanying adaptation to an aquatic career.

Mr. Arthur Hollick presented a specimen of soapstone rock from the Clove road outcrop, showing well preserved glacial striations, or possibly "slickenside" markings, neither of which had been previously noted from such rock, probably on account of its being so soft and easily weathered.

January 10th, 1891.—Mr. Arthur Hollick read the following notes upon additions to the flora of the Island, illustrated by specimens:

Since the last appendix to the "Flora of Richmond County" was published, about two years since, a number of important finds have been made. Some of these are of plants not previously found on the Island, others are of plants which had been previously reported but not verified by specimens, while others are of importance as new localities for rare species. I take pleasure in acknowledging our indebtedness to the members of the Torrey Botanical Club, who are responsible for seven of the finds, discovered during several field-day excursions to the Island.

Ranunculus lacustris Beck and Tracy. Abundant in a pond on Ocean Terrace, near the Vanderbilt mausoleum; only known previously from a pond near Court House Station.

Tilia americana L. Richmond (Wm. T. Davis.) These trees were discovered May 30th, 1888, but it was not until the following year that the flowers were obtained and the species positively identified. The trees are few in number, and grow in the woods near the defunct North and South Shore R. R. So far as we know, they are the only native lindens on the Island.

Euonymus europæus L. Escaped along a roadside near Richmond Valley.

Eupatorium hyssopifolium L. Pleasant Plains.

Aster radula Ait. Arlington. (Dr. R. G. Eccles.)

Hieracium aurantiacum L. Rossville; in grassy ground, near the shore.

Veronica chamædrys L. Prince's Bay. (Mrs. N. L. Britton.)

Salix purpurea L. Abundant along roadsides near Rossville. Probably the relics of old basket-willow plantations.

Habenaria ciliaris (L.) R. Br. Old Place (Wm. T. Davis) and Bogardus's Corners.

Habenaria blephariglottis (Willd.) Torrey. Arlington. (Dr. R. G. Eccles.)

Microstylis unifolia (Michx.), B. S. P. Near Egbertville (Mrs. N. L. Britton), and Ocean Terrace, near Four Corners. This inconspicuous little orchid has recently been found in comparative abundance at both localities, and may probably be looked for in similar situations elsewhere. It was admitted into the original "Flora of Richmond County," published in 1879, upon the strength of a single rather poor specimen found by Judge Addison Brown "in a glen near New Dorp," and until another specimen was found by Mrs. Britton about three years ago this was the only voucher which we had to show as evidence of its occurrence here.

Liparis lœselii (L.) Rich. Garrettson's; one specimen only. (Miss Millie Timmerman.) This species was admitted into the original catalogue on the authority of I. H. Hall, in the Bulletin of the Torrey Botanical Club for April, 1874, where there is a note to the effect that it was found "on Staten Island, in the gravelly bank of a railroad cutting."

Cypripedium acaule Ait., forma *alba*. A single specimen of this albino was found by Mrs. Edward Heylyn. The exact locality is not known to me.

Belamcanda chinensis (L.) Red. Tottenville; along a brook.

Tradescantia virginica L. Bogardus's Corners; evidently spreading.

Eleocharis palustris (L.) R. Br., var *glaucescens* (Willd.) Gray. Common.

Scirpus olneyi Gray. New Dorp.

Glyceria distans (L.) Wahl. New Dorp.

Panicum miliaceum L. Todt Hill road, near Moravian Church.

Association of American Anatomists.—The next meeting will be held at Washington, D. C., in September, 1891, at or about the time of meeting of the Congress of American Physicians and Surgeons. The officers for that meeting are as follows: President, Joseph Leidy; vice presidents, Frank Baker, F. D. Weisse; secretary and treasurer, D. S. Lamb; executive committee, Harrison Allen, Thomas Dwight, and B. G. Wilder.

SCIENTIFIC NEWS.

The Royal Society of Canada announces its annual meeting in Montreal, May 27th, the session lasting one week. In the words of the preliminary circular, which has been mailed to us, it is anticipated that the meeting will be attended by many distinguished persons, eminent in literature and science, from Europe and the United States, as well as from the Dominion of Canada. The ordinary sessions of the society will be held in the buildings of the McGill University, and the popular evening lectures will be delivered in the Queen's Hall on St. Catherine Street. The museums and art galleries, with the educational, industrial, and other institutions of the city will be opened to visiting members and associates. Local excursions to places of interest in the neighborhood will be arranged for, and receptions, garden parties, and entertainments of various kinds will also be provided. It is also proposed to keep a directory, wherein the names and addresses of all those attending the meeting will be registered, and thus members and associates will be enabled to communicate one with another without delay. The committee are engaged in the preparation of a hand-book, for gratuitous circulation among intending visitors, which will include an historical account of the society, together with other interesting scientific and local information, a copy of which will be sent on application. Sir Donald A. Smith is chairman, and J. A. Beaudry, C.E., and W. J. Smyth, Ph.D., honorary local secretaries. All persons interested in literature and science may become associates for this meeting, and are cordially invited by the local committee to be present thereat.

Joseph Leidy, M. D., Professor of Human Anatomy in the University of Pennsylvania, and president of the Academy of Natural Sciences of Philadelphia, died April 30th. He was born in Philadelphia, September 9th, 1823. His father, Philip Leidy, was a native of Montgomery county, Pa., and his ancestors on both sides were Germans from the valley of the Rhine.

His taste for natural history was exhibited at a very early age, and received judicious encouragement from the master of the school where he acquired the rudiments of an English education. At the age of sixteen he left school with the intention of becoming an artist, as his father proposed.

In the meantime, however, much of his leisure had been passed in a wholesale drug store near his home. His time here was so well spent that the proprietor did not hesitate, when an opportunity offered, to recommend him as competent to take temporary charge of a retail drug store belonging to a customer. He was encouraged by his success in filling the trust thus reposed in him to study the properties and art of compounding drugs as a profession. His study of nature, while thus occupied, had not been neglected. To botany and mineralogy he had added comparative anatomy, his first practical studies in that branch having been made on a barn-door fowl and a common earthworm. So absorbed did he become in his anatomical studies that, at the suggestion of his mother and with the consent of his father, he gave up all intention of becoming either artist or apothecary, and resolved to devote himself to that profession which would afford him the best opportunity for pursuing those studies from which it was now evident he could not easily withdraw himself. In the autumn of 1840, therefore, he began the study of medicine, devoting his first year to practical anatomy.

Having entered the office of Dr. Paul B. Goddard, he attended three full courses of lectures in the University of Pennsylvania, presented a thesis on "The Comparative Anatomy of the Eye of Vertebrated Animals," and graduated as doctor of medicine in the spring of 1844. Immediately after receiving his degree his first work in connection with the university was as assistant in the chemical laboratories of Drs. Hare and James B. Rogers. He began the practice of medicine in the fall of 1844, and continued it for two years, when he resolved to devote himself entirely to teaching. He was elected Professor of Anatomy in the University of Pennsylvania in 1853. In 1871 he was appointed Professor of Natural History in Swarthmore College. In 1845 he was elected a member of the Philadelphia Academy of Natural Sciences, and in 1846 the chairman of its board of curators. In 1882 he became its president.

Dr. Leidy's work covered a wide range of subjects. He was a good mineralogist, botanist, and zoologist. His original work was done in zoology and in the paleontology of the Vertebrata. He first determined the identity of the *Trichina spiralis* of man with that of the hog, and discovered many new forms of Entozoa. His early researches into the anatomy of insects and of other invertebrates are well known. His later work was in the field of vertebrate paleontology, of which science in America he laid the foundations. His most important work outside of this field is his Monograph of the Fresh-Water Rhizopoda of North

America, which is especially valuable for its admirable illustrations, drawn and colored by himself.

Dr. Leidy received the Walker prize of the Boston Society of Natural History, and the Lyell medal of the Geological Society of London. He received the degree of LL.D. from Harvard University. At the time of his death he was president of the faculty of the Wagner Free Institute of Science, and of the Department of Biology of the University of Pennsylvania; also of the American Anthropometric Society, to which body his brain has been committed for examination and report.

Professor Leidy was a man of fine presence, and was possessed of a sonorous voice. He was an admirably lucid lecturer, and had excellent artistic skill. In his disposition he was retiring and even timid, and his sympathies were easily roused. His interest was readily enlisted on behalf of "the under dog in the fight"; and the person who appealed to this side of his character was rarely disappointed. From an intellectual point of view, he was an acute and accurate observer, and a tireless investigator. Of the systematic and generalizing faculties he possessed little, and for this reason he was no organizer of men. In fact, he was indifferent to this aspect of human relations, being an "individualist" in this respect, as he was in his scientific pursuits.

American science has sustained a severe loss in the death of Leidy. His life has been a stimulus to the progress of intellectual pursuits in this country, and it will produce much fruit in the future, as it has in the past. Honors came to him and his fellow-citizens will honor themselves by erecting to him a permanent memorial in some conspicuous part of the city of his birth.

WE regret to announce the sudden death, on February 13th, at the age of 77 years, of **Mr. William Davies,** F.G.S., for forty years of the Geological Department of the British Museum, from which he retired as senior assistant some two or three years ago. This veteran paleontologist was widely known and highly esteemed by scientists of all countries for his great knowledge of the fossil back-boned animals, and for the genial readiness with which he imparted it to students and inquirers. His official duties necessarily brought him into frequent contact with the numerous distinguished pilgrims from all parts of the world to the great shrine of natural history in London. His recollections went back to the days of Dean Buckland, Agassiz, Owen, Mantell, Phillips, Hugh Miller, and other great pioneers and founders of the sciences of geology and paleontology. No one, perhaps, regretted

more than he did the removal of the natural history collections from the historic galleries in Bloomsbury. It is certain none labored more strenuously to effect their safe transfer to their new home at South Kensington, and the arrangement of the gallery of fossil fishes, containing the finest collection of fossil fishes in the world, was his especial pride and care. Mr. Davies was remarkable for his unaffected simplicity of manner and modesty of character. He occupied the somewhat rare position in these scribbling days, of knowing more than he wrote, instead of writing more than he knew. Nevertheless, Mr. Davies contributed several instructive and interesting papers to the *Geological Magazine*. In one, "On the Omosaurus," he described the removal to the museum workshops of the huge septarian nodules from the Kimmeridge clay of Swindon, Wiltshire, and the subsequent development therefrom of the remains of "that gigantic British dragon of old time," the *Omosaurus armatus* of Owen, one of the finest specimens of its class in the National Museum. The descriptive catalogue of the Plistocene mammalian remains from Ilford, Essex, of Sir Antonio Brady's collection in the British Museum, was also from his pen.

Some rather sensational journalistic articles were published at the time about this fine collection, comprising the remains of parts of the skeleton of a considerable number of individual specimens of various Rhinoceri (*R. leptorhinus*), primeval oxen (*Bos primigenius*), deer, and especially of the mammoth (*Elephas primigenius*) from the Pleistocene deposits of the valley of the Thames. Mr. Davies used to relate that for some time afterwards people came to the museum and inquired anxiously for the British elephants, and went away quite angry and disappointed when they were shown the series of detached bones, not in the least realizing that a *single* bone often sufficed an anatomist for the reconstruction of an individual animal. They really seemed to expect to see the one hundred and fifty Essex elephants set up all in a row.

Mr. Davies was a great lover of nature, and enjoyed many a botanical ramble over the South Downs; but even when out for a holiday it was not easy to keep him long out of a museum. Then nothing delighted him more than to pore over a nondescript heap of old bones that every one else had given up as hopeless. It was marvelous to watch the patience and skill with which he would select and fit such rough fragments together, and finally build up the limb bone of a rhinoceros or or the spinous processes of the vertebra of an Iguanodon. Mr. Davies will be sincerely regretted by his former chiefs and colleagues, and by many friends. His end was doubtless hastened by anxieties concerning

the illness of his only son, Mr. Thomas Davies, F.G.S., senior assistant of the Mineralogical Department of the British Museum.—Agnes Crane.

Dr. John LeConte, Professor of Physics in the University of California, died April 29. He belonged to a distinguished scientific family. His father and uncle were both naturalists. His younger brother is a prominent geologist and chemist, and his nephew was an explorer and naturalist and served as chief clerk in the United States mint in this city for the five years preceding his death.

John LeConte was born in Liberty county, Georgia, on the 4th day of December, 1818, graduated at Franklin College, University of Georgia, in 1838, and studied medicine at the College of Physicians and Surgeons of New York, where he graduated in 1841. He settled in Savannah, Ga., in 1842, and there began the practice of his profession, but in 1846 was called to the chair of Natural Philosophy and Chemistry in Franklin College, which he held until 1855. He lectured on chemistry at the College of Physicians and Surgeons, New York, in 1855–56, and in 1856 became Professor of Natural and Mechanical Philosophy in South Carolina College, at Columbia. In 1869 he was appointed Professor of Physics and Industrial Mechanics in the University of California, and after holding the office of president of the university, in addition to his chair, from 1876 until 1881, he retired to the chair of Physics, which he retained up to the time of his death. His scientific work extended over fifty years.

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